5th and 8th grade pupils' and teachers' perceptions of the relationships between teaching methods, classroom ethos, and positive affective attitudes towards learning mathematics in Japan

By

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ABSTRACT

This study investigates teachers' and pupils' perceptions of pupils' enjoyment, motivation, sense of security and sense of progress in mathematics learning in relation to their perceptions of eight teaching methods in mathematics classes at 5th and 8th grade in Japanese schools in Tokyo. This study explores whether the attempts of the education ministry of Japan in its educational reforms of 2002 which suggests the deployment of a more varied range of teaching methods in mathematics classes will satisfy pupils' individual learning style preferences and improve their attitudes towards learning mathematics. 48 5th grade teachers and 1479 of their pupils belonging to 28 elementary schools, and 42 8th grade teachers and 2156 of their pupils belonging to 19 junior high schools took part in the questionnaire survey. 31 teachers were interviewed.

The findings showed that the adoption of various teaching methods may satisfy individual differences in affective attitudes at both grades. However, teachers' dichotomised beliefs about the relationship between enjoyment and sense of progress in mathematics learning, lack of confidence in their teaching skills, and lack of resources were the main obstacles to deploying recently developed teaching methods at both grades. The heavily loaded curriculum was also an obstruction particularly at 8th grade. To improve pupils' attitudes towards learning mathematics, teachers should consider the effective deployment of a range of teaching methods, enhancing the classroom environment, and pupil support, while the Japanese government needs to consider improving teacher training and resources, developing an appropriate senior high school entrance examination and textbooks in order to promote the adoption of a diverse range of teaching methods in mathematics classes. Consideration also has to be given to the cultural context, because teachers' and pupils' perceptions of the teaching methods are affected by the cultural and historical backgrounds within which education in Japan is embedded.

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CHAPTER 1: INTRODUCTION

1.1: What are the overall aims of this study?

This chapter describes the overall aims of this study, the background to it and the main research questions. The research, overall, aims to examine teachers' and pupils' perceptions of whether widening the range of teaching methods adopted in mathematics classes can positively promote pupils' affective attitudes towards learning mathematics. The research is motivated by the educational reforms which the Ministry of Education in Japan introduced in the Course of the Study for 2002. The Course of Study is the main resource and reference for schools and teachers reflecting on their practice in relation to curriculum issues. It includes general educational aims and the curriculum which is to be covered. It also includes guidance on planning, teaching classes and assessing pupils' performance across all subjects and for every specific subject. Whitburn (2000) noted that the course of study for mathematics education in Japanese schools specified both topic content and how it should be taught more clearly than the National Curriculum in England and Wales. The level of detail in the course of study is to help Japanese teachers to have a shared interpretation of the curriculum.

Mathematics has been the focus of considerable educational reform in Japan. The Ministry of Education (1999) established two aims for mathematics education, which are common for both elementary and junior high school levels. One is to ensure pupils' acquisition of fundamental mathematics competencies. The other is to promote pupils' positive attitudes to learning mathematics. The latter aim arose as a result of international surveys such as SIMS (Second International Mathematics Study) and TIMSS (Third International Mathematics and Science Study) in which Japanese pupils reported negative attitudes to learning mathematics, although they performed well in the subject. The Ministry of Education in Japan has attempted to achieve these aims in mathematics teaching through two measures. One is the reduction of the curriculum content. The other is through widening the range of teaching methods deployed in mathematics classes (Ministry of Education, 1999).

The purpose of this study, which explores the current implementation of different teaching methods and their perceived effects on pupils' affective attitudes in mathematics classes, is to inform future policy and practice. The study does not aim to contribute to knowledge about how the mathematics curriculum might be improved. It investigates the issues through analysing the perceptions of teachers and pupils, adopting a psychological perspective.

1.2: Why is this study important?

Pupils' attitudes towards learning mathematics have been, to some extent, investigated in international surveys such as SIMS and TIMSS. Kifer et al. (1989) believe that researching teachers' and pupils' perceptions is important for three reasons. First, aptitude measures or assessments of prior performance predict some, but not all of the variation in achievement, therefore other non-cognitive or affective variables must play a major role in determining cognitive outcomes. Secondly, pupils' attitudes to learning are an outcome of schooling. Lastly, the perceptions of students and teachers reflect how they perceive and respond to what happens in school; such perceptions represent the values and norms of broader social structures or cultural milieu in a school setting.

Some research supports the view that pupils' cognitive outcomes need to be considered in relation to their affective attitudes towards learning. Imai (1990) reported that when 7th graders' mathematics performance deteriorated there was a decrease in pupils' liking for mathematics, motivation, value placed on attainment and mathematics self-concept. At the same time a decrease in pupils' liking and value placed on attainment led to deterioration in mathematics performance. This produced a vicious circle. A sense of efficacy led to high achievers' improving mathematics performance, but a liking for mathematics was important to improve low achievers' mathematics performance. Similarly, Kusumoto (1998) reported that Japanese 5th and 6th graders who disliked mathematics spent less time learning mathematics than those liking mathematics, although both groups believed that learning mathematics was important. Where pupils liked mathematics classes and the mathematics teacher, they were motivated to learn mathematics (Imai, 1993).

Given that not only Japan but other countries are trying to improve pupils' attitudes towards mathematics as one of the main goals of mathematics education (Robitaille, 1997), examination of pupils' attitudes to learning mathematics is also important in terms of the social expectancies of schooling. In Japan, supporting children's emotional development is not restricted to those specifically responsible for moral education, but is expected to be undertaken across all subject classes (Ministry of Education, 1999). Parental expectations of school have been interpreted as including both cognitive training and moral development (Fujita, 1978). This characteristic of education is often described in other countries as developing the well-rounded, whole person (Cummings, 1980), or whole-child education and values-rich education (Lewis, 1995). These qualities of Japanese elementary education are seen to be responsive to children's needs for belonging, contribution and competence (Lewis, 1995). In the UK, 'spiritual, moral, social and cultural development' (DES, 1992a) is one of the aims of education across all subject classes (e.g. DfEE, 1999). The USA also emphasises affective responses in learning such as confidence, interest, perseverance and curiosity (Commission on Standards for School Mathematics, 1989).

Despite the importance of pupils' attitudes towards learning, most research has focused on their levels of achievement. For instance, studies of the relative effectiveness of different teaching methods have been conducted since the 1970s in the UK and USA. Studies known as aptitude-treatment interaction (ATI) specifically paid attention to the relationships between the effectiveness of teaching methods and pupils' individual characteristics (Entwistle, 1972). For instance, Hodges (1983) and Dunn (1989) argued that the cause of mathematics anxiety lay in the mismatch between individual preferred learning styles and the learning styles actually employed in mathematics classes. However, almost all of these studies consider the relative effectiveness of teaching methods for improving pupils' achievement, not their attitudes. Equally, the Japanese mathematics education system has been much researched, but most studies have examined, through observation in Japanese elementary schools, the effects of the policies, teaching materials and teaching instruction on pupils' achievement (eg. Stigler et al. 1988 in USA; Stevenson et al, 1992 in USA; Whitburn, 2000 in UK). These studies paid little attention to pupils' attitudinal responses to the teaching methods deployed in lessons.

The lack of research about pupils' attitudes is in part due to the influence of behaviourism on educational psychology, which has stressed the relationships between stimulus and response, that is, teaching methods and pupil achievement. It is also in part due to the difficulty and complexity of investigating pupils' attitudes compared to cognition (Gardner, 1985; McLeod, 1992). For instance, the ATI research mentioned earlier did not develop extensively because of the complexity of individual differences and the ambiguity of the effects of strategy and situation on intelligence, personality and behaviours (Hallam, 1999). Thus, despite the importance of examining pupils' affective attitudes towards mathematics learning in terms of cognitive outcomes and social expectancies of schooling, the field is relatively under developed.

1.3: What are the specific problems of Japanese students?

The specific problems of Japanese students identified in their affective responses to mathematics, which were revealed in international surveys such as SIMS and TIMSS, were:

- negative attitudes towards mathematics,
- lack of motivation to learn mathematics,
- feelings of anxiety or difficulties in learning mathematics, and
- lack of confidence in their performance.

There is much evidence reporting Japanese pupils' negative affective attitudes towards mathematics learning. The results of TIMSS showed that neither 4th nor 8th graders expressed positive attitudes towards mathematics, either in terms of liking mathematics or enjoying learning the subject. Their attitudes worsened as they proceeded through the grades (National Institute for Educational Research, 1997, 1998). The results of SIMS showed that 7th graders believed that doing well in mathematics was relatively important to them, but overall did not appear to like learning mathematics. Overall, junior high school students' attitudes towards mathematics worsened over time, in comparison to the results of FIMS in 1964 (Husen, 1967).

Some possible reasons for the deterioration of older pupils' affective attitudes towards mathematics learning have been suggested. Firstly, older pupils become increasingly unsure about the effect of effort on their mathematics outcomes. Fuji (1992) reported that children came to believe less that they could succeed in mathematics learning through effort or through enjoying mathematics learning. Secondly, older pupils become less likely to find value in mathematics learning. Sanada (1994) reported that Japanese 7th-9th graders valued mathematics when they were able to make use of mathematics knowledge in everyday life, but Fujii (1992) reported that as pupils advanced through the grades they came to believe less that learning mathematics would be useful in everyday life. Thirdly, older pupils are more extrinsically motivated and tend to lose their intrinsic motivation in mathematics learning. The results of SIMS and TIMSS showed that pupils wanted to learn mathematics for the sake of the entrance examinations to high school or university, not because they liked learning mathematics. Lastly, some authors have commented that the current examination may not be a strong elicitor of positive motivation in children, except for a limited number of top performers. This is increasingly because academic credentials are not perceived as important in social mobility, and people seek fulfilment in their lives outside educational aspirations. This may apply to junior high school students who face senior high school entrance examinations (Amano, 1989, Fujita, 1993).

Japanese students also revealed their lack of confidence in learning mathematics in the international survey. Japanese 8th graders taking part in TIMSS overall did not think that mathematics was an easy subject to master. The percentage of pupils perceiving that mathematics was easy subject to master decreased from 40% at 4th grade to 13% at 8th grade (National Institute for Educational Research, 1997, 1998). More than half of the Japanese 8th graders replied that they were poor at mathematics, despite that majority of them performed well. The lack of confidence was also found in the perceptions of younger children and their mothers. Kimura (1989) reported that two-thirds of 5th graders stated that their mathematics performance was average, while half of American 5th graders stated that their performance was above average. Crystal et al. (1991) reported that 79% of Japanese 1st and 5th graders' mothers perceived that their children managed to learn fundamental mathematics skills, but had difficulties with applied problems in mathematics.

Teachers are encouraged to promote pupils' understanding of a wide range of mathematics contents (Schmidt, 1997). The textbooks cover all required topics in a way which aims at the logical development of progress through the curriculum (Whitburn, 2000). Teachers of both elementary schools and junior high schools are encouraged:

- to promote pupils' fundamental knowledge and skills,
- to promote pupils' ability to apply such fundamental knowledge and skills in everyday life,
- to promote pupils' ability to relate new mathematics conceptual structures to their existing knowledge, and
- to develop pupils' thinking abilities including intuition, prediction, inference, induction, deduction, examination and expression. (Ministry of Education, 1999).

Teachers also appear to value pupils' affective attitudes towards mathematics learning. The results of SIMS showed that most of teachers of 7th graders in Japanese schools thought that having their pupils become interested in mathematics was more important than improving their mathematics competencies. In addition, the proportion of teachers valuing the promotion of pupils' interest in mathematics was larger than that of teachers of other participating countries (Robitaille, 1992). These findings reflect Japanese educational culture, in which promoting the spiritual aspects of education is stressed more than the acquisition of knowledge and skills (Okamoto, 1992).

Some research, however, has reported that teachers' and parents' attitudes may have negative effects on pupils' affective attitudes towards mathematics learning. Firstly, people appear to believe that enjoying mathematics learning and doing well in mathematics learning are separable, but also that enjoying mathematics learning is more difficult to achieve than succeeding in mathematics learning. For instance, Mori's (1998) study showed that most parents believed that children could succeed in learning mathematics through effort, but half felt that not all children could enjoy learning mathematics. This dichotomised view of the importance of learning mathematics versus enjoyment in mathematics learning was also reflected in teachers' attitudes. Robitaille (1989) reported that Japanese teachers of 7th graders believed that teaching mathematics was important, but they generally did not like teaching mathematics. Secondly, teachers may not employ effective measures to promote pupils' affective attitudes, such as reducing pupils' anxiety about mathematics learning. Stevenson (1993) pointed out that Japanese textbooks were difficult to understand because of the early appearance of complex materials. Many Japanese teachers reported in SIMS that their pupils felt anxiety about learning mathematics, and suggested that this anxiety might hinder their mathematics attainment. However, not many teachers were willing to deal with such pupil feelings (Robitaille, 1992).

Overall the evidence suggests that Japanese students, especially in junior high schools, show negative attitudes towards learning mathematics due to extrinsic motivation, an ability-based attribution style, decreased value for mathematics learning and decreased outcome expectancy of success in mathematics learning. They also have reduced confidence in mathematics learning. While teachers appear to attempt to promote pupils' competence in, and positive affective attitudes towards, mathematics learning, their belief that performance outcomes and enjoyment in mathematics learning are separable, and their relative lack of concern for pupils' affective attitudes, may have negative effects on pupils' affective attitudes towards mathematics learning.

1.4: Widening the range of teaching methods deployed in mathematics classes

The Ministry of Education in Japan (1999) wishes to improve pupils' affective attitudes towards mathematics learning, and widening the range of teaching methods deployed in mathematics classes will be one of the measures to achieve this. Japanese teachers are reported to be eclectic in their approach to teaching mathematics (National Institute for Educational Research, 1997). For instance, teachers introduce several activities on the same topic to stimulate pupils' motivation and promote their understanding (Stevenson et al., 1992, Lee et al. 1998, Stigler, 1998). Some adopt short, frequent periods of seatwork and whole-class sessions alternatively (Stevenson et al., 1992). Some adopt co-operative work and a whole-class focus alternatively (Tsuchida et al, 1998).

The Ministry gives several reasons for teachers adopting a diversity of teaching methods in mathematics classes; firstly, this can promote pupils' understanding of the content, and in turn, their sense of progress and motivation. The Ministry describes such a sense of progress as 'intellectual growth' and 'intellectual satisfaction' and believes that it becomes more important for junior high school students who have developed logical and abstract mathematical thinking. The Ministry believes that reducing pupils' experiences of difficulties in learning mathematics can ensure that pupils feel security in mathematics learning. Secondly, the adoption of various organisational styles in mathematics classes is assumed to trigger pupils' intrinsic motivation by changing the teaching approach from teacher-led to pupil centred methods (Ministry of Education, 1999). It values pupils' autonomy and self-determination in learning, and promotes learner participation. It is believed that taking part in a diverse range of mathematical activities, including both practical and mental activities, which are believed to stimulate all pupils' strengths, will provide pupils with enjoyment, and a sense of fulfilment, invention, surprise and inspiration.

The Ministry proposes that the adoption of various organisational styles in mathematics classes should also be encouraged for the sake of children's moral and personal development (Ministry of Education, 1999). Diversity of methods is assumed to be able to provide children with opportunities to explore the "goodness of self" and others through sharing their views with others, self-reflection and peer evaluation. These experiences are expected to promote children's moral and personal development. Adoption of various organisational styles in mathematics classes is also assumed to make learning mathematics more meaningful by linking what they have learned in their mathematics classes to everyday settings (Ministry of Education in Japan, 1999).

The Ministry also suggests that the adoption of a variety of organisational styles in mathematics classes can satisfy individual differences (Ministry of Education in Japan, 1999). Some research has indicated that many teachers believe that suitable teaching methods differ according to the individuals' current attainments and motivation. Thus, adopting a teacher-led, explanation-based teaching method with a whole class is suitable for pupils who are poor at mathematics, and for unmotivated pupils, especially in older grades. Similarly, teachers believed that giving the right answers and direct teacher guidance through teacher-led, explanation-based teaching methods could improve the knowledge of pupils who are not able to learn from their mistakes (Ishida et al., 1986, Kajita et al, 1985). Teachers believed that classes proceeding at the same pace as other peers, reading a textbook and learning from descriptions on the black board, provided a sense of security to pupils who were not good at mathematics, especially in the case of older children (Nakano, 1990). Teachers believed that the elicitors of pupils' motivation in mathematics learning differed according to pupils' attainments. Imai (1995) reported that junior high school mathematics teachers believed that intense relationships with the teacher promoted the motivation of middle level of achievers, and informing pupils of the value of mathematics learning and reducing anxiety were important to promote the motivation of lower achievers. On the other hand, they believed that developing pupils' mathematical ideas through pupil-centred, exploratory-based teaching methods in mathematics classes was beneficial for pupils who were good at mathematics (Ishida et al., 1986; Kajita et al, 1985; Nakano, 1990; Imai, 1995). The deployment of a wider range of teaching methods in mathematics classes might believed as effective in promoting pupils' positive affective attitudes, especially in Japanese schools where grouping pupils by ability is not the prevailing practice.

Recommendations to adopt a diversity of teaching methods in mathematics classes appear in the educational policies of other countries as well as Japan. For instance, deploying various teaching methods such as practical activities, ICT, and discussion in mathematics classes is regarded as broadening the students' learning opportunities in the UK (Ofsted, 1995a, Ofsted, 1995b). Schools in England and Wales are expected to select teaching methods which promote high levels of knowledge, understanding and thinking, and ensure pupils' engagement with, concentration on and motivation to complete tasks (DFEE, 1999). Alexander et al. (1992) argued that decisions on class grouping and teaching methods are not simply a question of mathematical proportion, but of 'fitness for purpose'. They suggest that traditional and progressive, direct and indirect teaching should be balanced. Encouragement for teachers to select appropriate teaching and organisational strategies were also introduced in the plan for the National Numeracy Strategy (DfEE, 1998a, 1998b, 1999). Brown's (1999a) synthesis of earlier studies suggested that effective mathematics teaching depends on the quality of the teaching such as the extent to which teachers interact with pupils but not on the organisational strategy adopted. Educators in the UK have begun to believe that adopting a diversity of teaching methods in mathematics is beneficial, especially for promoting pupils' understanding of the curriculum. However, Gipps et al (1999) reported that teachers in England felt that they needed to learn which approach was suitable for particular contexts.

In the UK, the Piagetian constuctivist model was widely adopted in mathematics education after the Plowden Report (Central Advisory Council for Education, 1967) was published. This report recommended the adoption of practical activities based on

Piaget's proposal that children find it easier to learn mathematics using concrete materials. Piaget (1969) stated that this condition continues until the formal-operational stage begins around the 11th year, when children begin to create mental structures using abstract thinking. Katz (1997) showed that project work provided opportunities to apply skills, addressed children's proficiencies, and encouraged intrinsic motivation. Adoption of problem-solving and the discussion of findings were also perceived to reduce pupils' mathematics anxiety by promoting pupils' understanding through helping them construct concepts (Greenwood, 1984). In contrast, rote-memorisation (Newstead, 1998) or the 'explain-practice-memorise' teaching paradigm (Greenwood, 1984; Skemp, 1986) were perceived as increasing pupils' anxiety in mathematics learning, because they did not help pupils to accommodate new knowledge into existing conceptual structures (Skemp, 1986).

In contrast, some have recommended a transmission model of teaching. Vinner (1994) suggests that the use of procedures and rules, which are cognitively simpler, clearer and easier to handle than concepts, and the focus on procedure rather than emphasising reasoning may provide pupils with a sense of security. A strong teacher presence in a transmission-type classroom can lessen discomfort and already-formed anxiety for some students who lack confidence in their own thinking skills (Clute, 1984; Norwood, 1994). Overall, different teaching methods are perceived to have an impact on learning outcomes. A transmission model of teaching is likely to be adopted where the curriculum is overloaded. For instance, Gipps et al. (1999) reported that some teachers in England adopted a transmission model of teaching after the introduction of National Curriculum in 1988.

Recently, a position which is a compromise between teaching methods based on the constructivist view and the transmission model has been studied in the UK. Askew et al. (1997) reported in the Study of Effective Teachers of Numeracy that better results were found, irrespective of the organisation of learning situations, when teachers adopted a connectionist position valuing pupils' discovery and the transmission of knowledge based on pupils' understanding. Teachers adopting a connectionist position were reported as taking time to share their positive attitudes towards mathematics learning with their pupils (also see, Brown, 1999a). The concepts of the connectionist position are theoretically the combination of Piagetian perspective and Vygotsky's (1981) 'social constructivist' model which values children's maturational processes and learning which, it is proposed, occurs through interaction with more competent partners. Shayer (1997) argued that a combination of group experimental activities and discussion would connect Piagetian and Vygotsykian perspectives and promote the mathematics performance of pupils of a wide range of attainment, because only the top 20% of the children in his study had developed formal operational thinking by the age of eleven or twelve.

Brown et al. (1999a) suggested the similarity between connectionists' views of mathematics teaching and the Japanese style teaching methods. Mathematics lessons in Japan normally start with examples connected with children's everyday life and lead to a formula, definition of terms and the statement of rules for performing mathematics operations. This is called the problem-solving teaching method, and consists of individual free orientation and verbalisation through discussion and explanation in a whole-class session (Whitman, 1997). This teaching method helps teachers to appreciate pupils' ideas and present lessons based on a detailed knowledge of each pupil's current understanding (Whitburn, 2000). This concept of problem-solving teaching in Japanese schools seems similar to interventions adopted in Shayer's (1997) study.

In summary, the Ministry of Education in Japan (1999) believes that widening the range of teaching methods adopted in mathematics classes could promote pupils' positive affective attitudes towards mathematics learning. It is perceived as promoting pupils' understanding of the content, triggering pupils' intrinsic motivation, supporting pupils' moral and personal development, increasing the value placed on mathematics learning and satisfying individual differences. Widening the range of teaching methods adopted in mathematics classes is also an international trend, particularly aimed at promoting pupils' understanding of the curriculum.

1.5: Other measures to promote pupils' affective attitudes towards mathematics learning

The Ministry of Education in Japan (1999) proposed several measures to promote positive affective attitudes in mathematics learning. The reduction of curriculum content specified in the current educational reform aims to promote such attitudes. The Ministry suggests that the reduction of taught curriculum content, and transition measures to support the later stages where there is difficult content can promote pupils' understanding of the selected curriculum content. The Ministry suggests that the reduction of the curriculum content can promote pupils' intrinsic motivation by allowing time for pupils to find what they would like to try to do or achieve in a more relaxed learning schedule.

The Ministry also believes that the learning environment can impact on pupils' affective attitudes towards mathematics learning. Firstly, the Ministry (1999) refers to appropriate evaluation systems in mathematics classes. The Ministry suggests that criterion-evaluation, self-evaluation and evaluations between peers, which emphasise pupils' learning processes and effort, can provide pupils with a sense of being accepted, positively valued and individually supported, and develop a sense of efficacy, and opportunities to learn from each other in a class. Such evaluation is believed to promote favourable attitudes towards mathematics learning more than strict normative evaluation, which focuses on measuring pupils' levels of knowledge and skills.

The Ministry also refers to the effects on pupils' affective attitudes of building up good relationships between teachers and pupils and between pupils in mathematics classes. The Ministry suggests that teachers should attempt to build good relationships in class and have a deep understanding of the individual child, in order to reduce pupils' anxiety. The Curriculum Council (1998), which was set up by the Ministry of Education to advise on the current curriculum reform, stated that teachers should develop a classroom ethos which allowed pupils to share their difficulties frankly and accept each other's mistakes and difficulties, and to provide children with a sense of security in learning. The council pointed out that pupils' enjoyment and motivation would be promoted if they had a sense of security within the classroom. Thus, the Ministry of Education in Japan also believes that reducing the curriculum content, the avoidance of strict normative evaluation, and building up good relationships in the classroom can promote pupils' favourable affective attitudes towards mathematics learning.

1.6: What teaching methods are adopted in mathematics classes in Japan?

Whole-class teaching

Japan has a long tradition of whole-class teaching. The UK inspectorate (DFE, 1992b) reported that the most common organisational strategy in the Japanese classroom was whole-class teaching in mixed-ability classes, usually of between 35 to 40 pupils. Much of the teaching was directed from the front, with pupils sitting in rows facing the board, although teachers sometimes moved around the room to provide individual support. Whitburn (1995) observed that 86% of the time in mathematics lessons was spent in whole-class teaching, compared with 11% working with individual pupils.

Three main advantages and one disadvantage of adopting whole-class teaching in mathematics emerge from the literature. Firstly, whole-class teaching is conceived to be effective for time and resource management (Whitburn, 1995; Edwards et al., 1996; Stevenson, et al. 1992a; Stigler, 1987, Reynolds, 1996). Teachers can maintain less complexity of classroom activity than when other organisational strategies are used (Creemers et al. 1988), and provide coherent, clear and practical demonstrations (Stigler, 1987; Mortimore, 1988; Lee et al. 1998). In short, teachers are more likely to have a sense of efficacy when deploying whole class teaching. Sugiyama (1987) in a questionnaire survey, showed that Japanese teachers believed that listening to teacher explanation was a more effective teaching method than reading a textbook, because it promoted pupils' understanding by managing class time effectively. Effective time and resource management by whole-class teaching is seen to promote pupils' intent concentration on work (Stevenson, 1995; Whitburn, 1995; Lee, et al., 1998; Alexander, 1992). Concentration on work is encouraged as part of Japanese educational culture, and children are trained to concentrate from the early years (Peak. 1991). Japanese mothers believe that children's poor attention to a task is a problem (Crystal et al, 1991). This is one of the reasons for the domination of whole-class teaching methods in mathematics classes.

Secondly, whole-class teaching is considered to develop pupils' mathematical thinking through interaction. For instance, The Ministry of Education in Japan (1999) claims that whole-class teaching can provide pupils with opportunities to learn from each other through interaction. The results of TIMSS showed that 71% of mathematics teachers involved in teaching 9th graders in Japanese schools have as the goal of mathematics classes the promotion of pupils' mathematical thinking such as the exploration of concepts, understanding them and finding several solutions to one problem. Only approximately three out of ten mathematics teachers give their goal as mastering and using formulas appropriately. In this sense, Japanese teachers do not adopt a transmission style of teaching in whole-class sessions. Fujii (1992) commented that this finding reflected the transition in the aim of mathematics education to emphasising the development of pupils' mathematical thinking which had occurred over three decades after FIMS in 1964.

Teachers attempt to develop pupils' inductive thinking (Stevenson, et al., 1992a). The mentioned above problem-solving teaching method is an example of the teaching methods to develop pupils' mathematical thinking in classes. Japanese teachers use questions to encourage pupils to explain their thinking, especially in relation to new material or novel solutions to problems, and encourage them to know other peers' views of their solutions (Stigler, 1998). Lessons consist of verbal explanations made by either students or the teacher, while rapid successions of short questions and answers are discouraged (Stevenson et al., 1992a). The percentage of total words spoken during this public discourse, the average length of the public conversations engaged in by students and teachers in terms of number of words, and the time devoted to one-to-one interaction are much higher in Japanese than in American classrooms (Stigler, 1998).

Lessons proceed at a slow pace and provide ample time to think (Stevenson et al., 1992a). Japanese teachers employ statements which hurry students, remind them of the time and redirect pupils' attention much less than American teachers (Tsuchida et al, 1998). Japanese teachers have been observed to be very successful in placing lessons in a meaningful context (Stevenson, et al., 1995). Teachers provide both conceptual and procedural information frequently, and pupils are encouraged to relate concrete problems and abstract principles. Word problems are frequently adopted, and pupils are encouraged to resolve problems by using alternative approaches (Lee et al., 1998). Evaluations by peers are encouraged. Instruction, practice and evaluations are adopted effectively in whole-class sessions (Lee et al., 1998). Making an error is relatively calmly accepted, and teachers attempt to use errors effectively as opportunities to promote pupils' understanding and rationales (Stevenson et al., 1992a, Stigler, 1998).

In addition, whole-class discussion is perceived as effective to promote pupils' mathematical thinking by stimulating other pupils' similar or opposing ideas (Orsolini et al. 1992). Hatano et al. (1994) found that through interactions pupils could incorporate discussed and negotiated meanings or understandings. The Cockcroft Report (Committee of Inquiry into the Teaching of Mathematics in Schools, 1983) mentioned that extended discussion is assumed to help pupils to understand different mathematical topics in an inter-related manner. Elaborating pupils' solutions to problems through explanation and discussion helps pupils with transferring their procedural memories to declarative memories, forming mathematics schemata and the processes of encapsulation of procedures (Davis, et al. 2000). Inagaki et al. (1998) investigated the effectiveness of whole-class discussion on the performance of Japanese 4^{th} and 5^{th} graders (10 years of age) and found that children could recognise and remember reasonable explanations offered by other pupils in the discussion and offer more or less plausible arguments for or against the alternatives which their classmates proposed, leading them to change and elaborate their opinions.

Pupils also acknowledge the importance of improving their mathematical thinking. Fujii (1992) showed that most students at both elementary school and junior high school believed that there were various ways of reaching solutions to mathematics problems. In his study, more than 80% of both elementary and junior high school students responded that the thinking process was more important than finding the answer. This was in contrast with most parents who believed that mathematics problems had only one answer. Most of the pupils who liked mathematics, in particular, believed that finding many solutions was most important in mathematics learning (Kusumoto, 1998).

Thirdly, whole-class teaching is considered to promote pupils' favourable affective attitudes towards mathematics learning, building confidence through peer interaction. Learning mathematics together in a class is seen as beneficial for some weaker pupils through vicarious learning (Bandura, 1986; Schunk, 1987; Akamasu, et al., 1974), especially through providing coping models, who overcome difficulties and gain in confidence through access to new awareness and insights from peers' practice (Thelen et al., 1979). This is especially the case for mathematics classes in Japanese schools where a class normally includes both high and low achievers (Uttal, et al. 1988). Whitman (1990), using a questionnaire survey found that most 8^{th} grade teachers in Tokyo believed that constructing effective whole-class sessions with warm, personal relationships with students was important, although working with the individual student was also valued. Stigler (1987) mentioned that whole-class discussion which provides pupils with a sense of commitment and mutual support in class promoted pupils' interest in learning mathematics and enhanced academic performance. Thus, discussion is perceived to promote pupils' positive affective attitudes towards mathematics learning as well as cognitive development.

The possible disadvantage of adopting whole-class teaching in mathematics classes is that this teaching method can lack consideration of individual needs. DeVito et al. (1989) suggest that whole-class teaching can lead to the image of an average child, and the teacher adjusting the individual child to that image. This may lead to teachers' believing that all children can learn mathematics up to a certain level, not taking account of individual differences. The earlier research suggested that whole-class teaching method was effective for time and resource management, promotion of pupils' mathematical thinking and promotion of their positive affective attitudes towards mathematics learning, while it might lack care for individual differences.

Group learning

The UK inspectorate (DFE, 1992) reported that group seating, which enables small group discussion in a group to take place, is used in some mathematics classes in Japan. The individual pupil is allocated to an individual desk. Desks are moved from row to group seating for collaborative work, and back to rows in the sessions requiring individual cognitive activities. Such desk arrangements matched to the characteristics of the task provided are beneficial for productivity of work and pupils' concentration on work, as Hastings et al. (1996) established in UK classrooms. Although group seating is not the dominant style of class organisation in mathematics classes, learning from peers is greatly encouraged from children's early days in the Japanese educational system. Children are reported to be well accustomed to learning in a group (Kotloff, 1998). Tsuchida et al's (1998) observation showed that Japanese teachers encouraged pupils to express both agreement and disagreement and elaborate on or respond to one another's responses much more frequently than American teachers. A mixed-ability grouping arrangement called *han* is often used to promote pupils' personal and social development in Japanese classrooms. Pupils share school life in a certain *han* for learning and other activities for several months (Duke, 1986). This familiarity among *han* members is believed to be beneficial given that Goldberg et al.'s (1965) study suggested that co-operation is better promoted in groups of consistent membership rather than when children are grouped with new children.

One learning style using small groups to achieve common goals adopted in the USA is called co-operative learning (Johnson et al. 1987). Group teaching is believed to promote not only pupils' cognitive competence but also their social competence. Pupils' involvement in group-activities can promote their motivation, and sustain their effort and concentration (Kyriacou et al., 1991). Group learning, which encourages an individual pupil's commitment as a component of a group (Johnson et al., 1992) and individual effort (Slavin, 1983, 1991) is assumed to produce high achievement. Such learning styles benefit all the children by improving their attainment, enhancing self-esteem, and promoting better attitudes towards mathematics (Ofsted, 1995). However, other research has suggested that the effect of co-operative learning on pupils' achievement is influenced by various factors, for instance, the characteristics of the pupil such as gender (Sadker et al. 1985), group composition, and the quality of group interaction (O'Donnell et al., 1992; Webb, 1982, 1989, 1992).

Individual teaching

As mentioned above, individual teaching is not popularly deployed in the Japanese classroom. Individualism is, in Japan, interpreted as relating to personality, rather than to the rights of individuals as secured by Article One of the education fundamental law (1947) and expressed in the Fourth and Final Report on Education Reform written by the National Council on Educational Reform in 1987. It is different from the Western view of individuality whereby children should receive education according to individual differences in abilities (Tsuneyoshi, R.K. 1991). Green (1998) explained that the relative equality within Japanese schooling is due to historical factors such as the state-led nation-building modernisation after the Meiji Restoration, the lack of social stratification and non-educational vehicles of social mobility, relative economic and cultural homogeneity, policies on education such as mixed ability classes and automatic promotion throughout the compulsory years, and cultural assumptions such as the effort-based attribution of achievement. Currently, provision for individual differences relies on private educational opportunities outside school. Developing innovative ideas through interactions and support for lower achieving classmates are measures commonly adopted to stimulate achievement in students in elementary and junior high school classrooms (Stevenson, et al. 1994). However, since the 1980s, equality in education has gradually come to be defined in two opposing ways. Teachers prefer unrestricted equality, which discourages competitive evaluation and ability grouping, while the liberationists of the Education Commission have encouraged differentiation according to student achievement (Tsuneyoshi, R.K. 1991). The Ministry of Education in Japan (1999) currently recommends the provision of more opportunities for individual and group learning, aiming to ensure all pupils' understanding while providing opportunities to meet individual needs and extend potential.

Some research has reported the advantages of individualised teaching methods which have been shown to be more effective, in relation to pupils' cognitive and affective outcomes, than whole-class instruction (Waxman et al., 1985). Shwalb (1991) reported that there were age and gender effects. 5^{th} grade boys in Japan were socially interactive and performed equally well in individualised and group conditions, while 8^{th} grade boys were more productive in an individual striving condition than group conditions. Individualised teaching methods also change the role of the teacher, from authority figure in teacher-led teaching methods to helper with the pupil's work in child-centred teaching methods (Langdon, 1976). However, individualised learning methods reduce the opportunities for interaction in mathematics classroom (Romiszowski, 1979) and are also likely to diminish the teachers' opportunities to develop their instructional skills because teachers rely on helping their pupils to complete the task rather than teaching them (Costello, 1991).

The small percentage of time allocated for individual work does not indicate a lack of emphasis on practice in mathematics classes at Japanese schools. Traditionally, Japanese education has emphasised a practical and pragmatic approach. For instance, calculating has been emphasised in mathematics classes since modernisation in the late

19th century and even before (Okamoto, 1992). Fujioka (1995) showed that elementary school mathematics teachers and principals, mathematics educators, professors of education, scientists, mathematicians, and engineers believed that understanding the system of numeration and fundamental operations, and adopting such knowledge skilfully were the first priorities in mathematics education. Japanese teachers were reported as promoting pupils' understanding by giving small numbers of problems at a slow pace and avoiding mechanical responses by letting children practise many problems (National Institute for Educational Research, 1997, 1998). The effects of this are that children become reflective and accurate on tests of cognitive learning; they are slow in the early years but gradually speed up as they get older (Salkind et al, 1978).

However, in the current reforms there is an attempt to reduce the time devoted to repetitive calculation practices, and increase time for developing pupils' mathematical ideas (Ministry of Education, 1999). One strategy is the introduction of calculators and the abacus as a necessity after 4th grade (Ministry of Education, 1999), although the adoption of calculators has so far been very limited at both elementary and junior high school levels (National Institute for Educational Research, 1997, 1998). The development of numerical understanding and competency in calculation is strongly emphasised at an early stage in elementary schools, as a foundation on which the more complex and later concepts of mathematics can be built (Whitburn, 2000). This approach whereby there is an emphasis on mental calculation in the early years and appropriate usage of calculators after children have mastered master the fundamental calculation skills, is also seen in the National Numeracy Strategy in the UK (DfEE 1998). Brown et al. (2000) showed that using calculators for conceptual purposes was associated with improvement in pupils' attainments.

Reading a textbook

In Japan, textbooks are considered to be the main material through which children experience the curriculum, because they are designed to follow the Course of Study and are approved by the Ministry of Education (DFE, 1992; Whitburn, 1995). Many people have analysed mathematics textbooks used in Japanese schools. Such analysis commonly reports that the textbooks are suitable for using in whole-class teaching but not individual work. Firstly, both elementary school textbooks (Whitburn, 2000) and junior high school textbooks (Mayer et al. 1995) contain ample worked-out examples and explanation, but few exercises for consolidation and practice by pupils. Secondly, both concepts and skills are presented earlier than in the USA (Fuson et al., 1988) and Hawaii (Whitman et al., 1997). Whitman et al. (1997) considers that Japanese students consolidate these concepts and skills through verbal communication. Stevenson et al. (1992b) undertook an analysis and concluded that the descriptions in mathematics textbooks adopted at Japanese schools were not very explicit because they aimed to develop children's mathematical thinking through children's exploration, elaboration and rationales rather than transmitting knowledge.

The results of the TIMSS survey showed that the majority of teachers of both 4th and 8th graders used textbooks to guide the content and instruction methods of mathematics lessons (National Institute for Educational Research, 1997, 1998). Japanese teachers are reported as feeling that it is easy to prepare for classes because of the common national curriculum, the high availability of precise teachers' manuals, ample opportunities to share teaching skills between teachers within individual schools and across schools and the small number of teaching hours allocated to individual teachers because of large class sizes (Lynn, 1988; Stevenson et al., 1992a; Whitburn, 2000). Foxman (1999) reported that more than 6 out of 10 Japanese elementary school teachers reported that their lessons were based on textbooks, although they combined their use of textbooks with considerable locally developed pedagogy (Whitburn, 1995).

Foxman (1999) reported that the percentage of Japanese students who perceived that teachers allowed them to use textbooks was also quite low for 8th graders, in international comparisons. However, 9 out of 10 Japanese students thought that memorising material from the textbook or notebook was important for better performance in mathematics (National Institute for Educational Research, 1997). Rholen (1995) takes the view that at the later stages of compulsory schooling, especially after grade 7, textbooks come to play a major role in teaching, in order to prepare pupils for entrance examinations. This may indicate that teachers use an exploratory style for lessons without textbooks, but students use textbooks to confirm what they have learned in classes by themselves when preparing for term examinations.

Activity-based learning

Activity-based learning, where pupils explore their own solutions to problems through activity and experience, is relatively new in Japan. In 1992, the UK inspectorate reported that activity-based learning including group work was conducted in few schools in Japan other than schools designated by the Ministry of Education as 'experimental' schools. In general, teachers were not accustomed to this style of teaching (DFE, 1992). The results of TIMSS showed that Japanese 4th graders hardly ever used objects they were familiar with in their everyday life to learn mathematics (National Institute for Educational Research, 1998). Stevenson et al. (1992a), however, observed that concrete objects were nearly twice as likely to be used in Japanese 5th graders' mathematics classes than with the same age group in American schools. The frequent adoption of this teaching method helped Japanese children to understand mathematical concepts earlier than American children, although by 5th grade the emphasis in mathematics classes in Japanese schools moved from dealing with concrete objects to visual presentation such as drawing, diagrams and demonstrations (Lee et al., 1998).

Since the middle of the 1970s, the Ministry of Education in Japan has attempted to introduce mathematics teaching methods, which develop pupils' discovery strategies and creativity. However, these attempts have not succeeded. This may be because, as researchers have reported, that while discovery and creative teaching methods were beneficial for promoting pupils' positive attitudes they did not promote achievement (Saeki, 1978). The Ministry of Education (1999) has advocated, in the Course of Study 2002, that opportunities to learn mathematics through experience and investigation especially needed to be introduced into mathematics classes in Japanese schools at both elementary and junior high school levels. The introduction of diverse styles of mathematics activities is believed to help change lesson styles from those dominated by teacher explanation to those where pupils can become more autonomously involved in lessons, promote their understanding and ability to apply mathematics, and engender more positive feelings about learning mathematics.

Using a computer

Computers at first tended to be used for school management rather than as teaching aids, according to a survey conducted by IEA in the 1980s, although the percentage of schools using computers as teaching aids had dramatically increased by 1992 in many countries. The position regarding using computers at school in Japan has followed this international trend. The introduction of the computer as a teaching aid increased from 12% of Japanese elementary schools in 1989 to 36% in 1992. In junior high schools, the percentage increased from 35% in 1989 to 71% in 1992, because of the introduction of information technology as a curriculum subject in 1993 (National Institute for Educational Research, 1995). In 1999, the Ministry of Education (1999) announced that using computers was particularly beneficial for teaching mathematics as it should develop pupils' intuitive sense and competencies in mathematical communication. Using the computer is also expected to promote pupils' interest in mathematical activities through exploring mathematical principles by visual means and also by promoting pupils' media literacy.

Japanese teachers believe that computers are easier to use in mathematics classes than other classes (National Institute for Educational Research, 1995). However, paradoxically, the results of the TIMSS survey showed that more than 90% of both elementary and junior high schools did not use computers for problem-solving in mathematics classes at all (National Institute for Educational Research, 1997, 1998). The two main reasons why teachers hesitate to use this teaching method in mathematics classes appear to be a lack of confidence in teaching mathematics through the computer, and doubts about the effects of this teaching method on pupils' cognitive and affective development. Teachers, overall, think that they lack sufficient knowledge and skills about utilising computers in lessons and regarding what software is suitable for teaching purposes. Teachers working in Japanese junior high schools do not believe that the introduction of computers as teaching aids will improve pupils' achievement or promote pupils' co-operative learning (National Institute for Educational Research, 1995).

Summary

This brief review of the literature suggests that the teaching methods adopted in mathematics classes in Japanese schools reflect the aims of mathematics education in Japan, which have valued the development of pupils' mathematical thinking since the 1960s. Whole-class teaching is the most frequently adopted teaching method, because teachers believe that this method can develop pupils' mathematical thinking through verbalised communication between teacher and pupil and between pupils. Group work is sometimes adopted to encourage pupils to learn mathematics in more familiar contexts. Individual work is not popularly deployed, because individual differences are given little attention. Both pros and cons exist for using textbooks in mathematics classes. Activity-based learning and using a computer are new teaching methods, and some teachers suspect the effectiveness of these teaching methods in promoting pupils' cognitive development.

1.7: The main research questions

This study aims to examine whether teachers and pupils perceive that widening the range of teaching methods adopted in mathematics classes is likely to positively promote pupils' affective attitudes, at 5th and 8th grades in Japanese schools. There were several reasons why 5th (10-11 year-olds) and 8th graders (13-14 year-olds) were chosen.

The choice of 5th graders, firstly, concerned the developmental transition in their abstract thinking. 5th graders are likely to be moving from the pre-formal operational stage to formal-operational stage (Piaget, 1967). The curriculum in mathematics education for 5th graders in Japan beings to include calculations using fractions and decimals which requires children to think abstractly. Therefore, the teaching methods deployed in mathematics classes at this stage held particular interest. Secondly, children begin to develop the capacity for self-criticism after age 9 (Gesell et al., 1946). Such self-criticism might affect their perceptions of self and their environment negatively. The third reason for choosing 5th graders was methodological. It was important to have comparability between questionnaires for elementary school children and those for junior high school children. Therefore, the target age needed to be chosen from the upper grade of elementary schools so that the approach to completing the questionnaire would be similar.

Seventh graders were not chosen because of their recent transfer to junior high schools. Sixth and 9th graders were not selected because many take examinations in years 6 and 9 and it would have been difficult to obtain school and parental permission.

Table 1.1: The educational phases in Japan

Year	Age	Stage (mainstream schools)	Stage (special need schools) Physical, visual, hearing impediment
1-6	6-12	Elementary schools	Elementary schools
7-9	12-15	Junior high schools	Junior high schools

Table 1.1 shows the educational phases in Japan. Children in Japan are in compulsory education for nine years from the age of 6. The first 6 years are for elementary school education, and the remaining 3 years are for junior high school education. Teachers teach all the subjects in elementary schools, while specialists teach for each subject in junior high schools. National tests are not adopted in Japan. Comprehensive style junior high schools do not have entrance examinations, but many children who want to proceed to private or national junior high schools need to take an entrance examination. All children take entrance examinations for senior high schools at the end of 9th grade. Mathematics is normally a compulsory subject in the entrance examinations.

To pursue the aim of examining whether teachers and pupils perceive that widening the range of teaching methods adopted in mathematics classes and to inform future policy and practice, the study explores the current implementation of teaching methods and their perceived effects on pupils' affective attitudes in mathematics classes. The Curriculum Council (1998) suggests that pupils' sense of progress, enjoyment, motivation, and sense of security are, to a certain extent, related. This view is supported by the Ministry of Education in Japan (1999). In the light of these policy documents, this study, specifically, takes up these four elements: enjoyment, motivation, sense of security and sense of progress, and sets out to answer three subsidiary questions.

Question 1: Do pupils in the 5th and 8th grades and their teachers perceive that a range of different teaching methods are deployed in mathematics classes and that pupils' enjoyment, motivation, sense of security and sense of progress are affected in a similar way by these different teaching methods?

The data from the research will be used to compare the perceptions of teachers of both age groups, pupils of both age groups and teachers and pupils within each age group. Such comparisons will reveal whether teachers' understanding of their pupils' attitudinal responses in terms of teaching methods is compatible with their pupils' perceptions.

Question 2: What contributes to pupils' enjoyment, motivation, sense of security and sense of progress in mathematics classes?

The Ministry of Education in Japan (1999) has suggested that valuing pupils' autonomy and self-determination in learning, securing pupils' sense of progress, and informing pupils of the meaning and purpose of learning mathematics can promote pupils' positive affective attitudes towards mathematics learning. What do teachers and pupils perceive as the factors contributing to pupils' affective attitudes towards mathematics?

Question 3: Do teachers and pupils perceive that pupils' attitudes to learning mathematics are affected by pupils' perceptions of self and classroom ethos and their motivational orientations? Are there any differences in perceptions between pupils of different ages and their teachers?

The Ministry of Education in Japan (1999) has suggested that promoting positive classroom ethos, for example by emphasising process and effort-focused evaluation, can promote pupils' enjoyment and motivation. Social acceptance between teacher and pupils and between pupils in classes, as well as enhancing pupils' competence beliefs, is seen as reducing pupils' anxiety. Kenneth (1989) argues that school and classroom conditioning as curricular contexts, and student background characteristics as curricular antecedents, may also affect student classroom behaviours. A further issue is therefore whether such environmental factors or student characteristics mediate pupils' attitudes towards learning, and whether such mediating effects are apparent in the pupils' perceptions of the effects of different teaching methods.

This study will explore through the use of interviews and questionnaires perceptions of pupils' affective attitudes towards mathematics learning and their relationship with the adoption of a wide range of teaching methods. Before describing the research itself, Chapter 2 reviews the literature relating to affect and learning, in order to further explore the background to the study and elaborate the main research questions mentioned above into subordinate research questions. Chapter 3 examines the methodological framework adopted in the research: a survey using a questionnaire and interviews. This chapter also describes the processes of planning and conducting the research in both the pilot and main studies. The results of data analysis addressing Questions 1, 2 and 3 are presented in consecutive chapters. One chapter is specifically prepared for describing the findings of teacher interview. The last chapter discusses the limitations of the study, makes suggestions regarding the deployment of particular teaching methods in mathematics classes in Japanese schools and suggests possibilities for future research.

CHAPTER 2: LITERATURE REVIEW

In this chapter the literature concerning the following research questions is considered.

- What contributes to pupils' enjoyment, motivation, sense of security and sense of progress in learning mathematics?
- Are these factors related to each other?
- Are there differences in pupils' attitudes towards learning mathematics between the later stages of elementary school and junior high school, and if so, why might such differences occur?
- Do pupils' perceptions of self, classroom ethos and motivational orientation affect their enjoyment, motivation, sense of security and sense of progress in learning mathematics?

This study aims to explore pupils' affective attitudes towards mathematics learning in relation to specific teaching methods. Hitherto, teaching methods in mathematics classes have mainly been studied in terms of their effectiveness in promoting pupils' achievement. Studies focusing on pupils' attitudes towards learning mathematics in relation to teaching methods have rarely been conducted. For this reason, this chapter reviews the literature on pupils' attitudes towards learning more generally. Pupils' perceptions of self, of classroom ethos and of their motivational orientations have been studied in the context of Japanese culture as well as in western cultural contexts. However, the relationships between these factors and pupils' affective attitudes towards mathematics learning in relation to specific teaching methods are un-researched. Although the literature reviewed in this chapter considers what we know from key research studies in western cultures, the emphasis is given to Japanese research where this has been undertaken.

2.1: Factors contributing to pupils' enjoyment, motivation, sense of security and sense of progress

Pupils' enjoyment

The Ministry of Education in Japan (1999) has proposed that one of the aims of mathematics education is that pupils should experience enjoyment in mathematics learning. This section will start by examining how theories define enjoyment in learning particularly in mathematics. Pintrich (1996) argues that participation itself becomes a reward for intrinsically motivated learners, while extrinsically motivated learners work on a task for desirable external outcomes. Thus, pupils who enjoy mathematics learning itself are intrinsically motivated to learn mathematics. The Ministry of Education in Japan (1993) defined intrinsic motivation as pupils' instinctive desire to evolve their potentiality.

The Ministry of Education (1993, 1999) has proposed that valuing pupils' autonomy and self-determination in learning and promoting pupils' positive perceptions of their own progress could enhance their intrinsic motivation. These ideas are supported by several theorists, although the stress given to pupils' autonomy and sense of progress varies. Harter's (1981) model of intrinsic motivation proposes that developing learners' ability to control the environment and satisfying their need to be autonomous and self-determined in learning contribute to promoting their intrinsic motivation. Her model is a refinement and extension of White's (1959) formulation of 'effectance motivation'. White's (1959) theory postulated that individuals are intuitively drawn to mastery and to efficacy in interaction with the environment.

Harter (1978, 1981) proposed that positive reinforcement or approval for attempts at independent mastery and lack of approval and reinforcement for dependence through child-rearing agents in the early years led to the child internalising a self-reward system and a system of standards or mastery goals. Such internalisation is assumed to develop perception of their competence and internal perception of control, which influences children's sense of intrinsic pleasure and enhances or maintains their effectance motivation to engage in subsequent mastery behaviours. Lack of reinforcement and/or disapproval for independent mastery attempts, and reinforcement for dependency on adults in the children's early years, result in the need for external approval and a dependence on externally defined goals for behaviours. Experience of failure in such conditions leads to feelings of low competence and the perception of external control of outcomes, which in turn, create anxiety in a mastery situation. As a result, motivation to engage in mastery behaviours reduces. Harter (1975) showed that the effectance motive operated across different developmental levels but became more focused as children grew older.

Deci's (1971, 1982, 1992) cognitive evaluation theory postulates that individuals' intrinsic motivation is enhanced by making the perceived locus of causality internal, or by improving pupils' perceptions of their own competence. All input relevant to the initiation or regulation of behaviour is seen to have three aspects. Informational aspects, supporting autonomy and facilitating competence, promote the individuals' intrinsic motivation. Controlling aspects, experienced as pressure to be controlled, promote the individuals' extrinsic motivation. Amotivating aspects, promoting or signifying incompetence, undermine both intrinsic and extrinsic motivation. Thus, Deci also emphasised the importance of autonomy, self-determination and perceptions of competence in learning. Bandura (1997) opposed Deci's (1975, 1982) controlling-informative dichotomy, and argued that the properties of incentives which maintain interest are challenge, which motivates people to cultivate competencies, and a sense of personal efficacy. In contrast, Deci (1994) suggests that the feeling of competence is not enough for promoting pupils' intrinsic motivation; it must be accompanied by perceived autonomy.

Although Japanese education is sometimes criticised because of its 'receptive' view of the learning process and the pupils' lack of autonomy (Kuryu, 1994), in fact children's intrinsic motivation and autonomy (Azuma, 1986), such as self-help (Tanner, 1977), self-monitoring of learning performance and self-reflection (Peak, 1991) have been valued in Japan. Learning by modelling and internal regulation through the learners' own understanding have been encouraged as desirable (Kojima, 1986). This is demonstrated in contemporary instructional styles, especially in Japanese elementary schools. A lack of extrinsic rewards, and an emphasis on pupils' understanding and enjoyment in the learning process, have been reported as examples of practice promoting pupils' intrinsic motivation (Lewis, 1992; Tsuchida, 1998). Many Japanese kindergartens have large classes. Japanese teachers also believe that learning with peers in a large class in the early years can avoid competition for the teachers' attention and approval and develop children's independence (Tobin, 1987, 1991). The Curriculum Council (1998) commented on the necessity of gradually promoting children's independence in both elementary and junior high schools. 'Being able to do things by oneself' is an aim for 3rd and 4th graders (Ministry of Education, 1998). 'To develop independent and self-reliant attitudes, to carry out faithfully what one has chosen to do and assume responsibility for one's own conduct' are targets showing the aims of junior high school students' independent spirit (Ministry of Education, 1983, 1998).

Independence has also been shown to be the most popular educational expectation of Japanese parents for their children (Sengoku, et al., 1985). Japanese mothers of pre-schoolers encourage children's independence through encouraging their social relationships with peers and doing things by themselves while maintaining emotional dependence (Osterweil, et al., 1991: Joshi et al., 1997). Japanese adults rely on children's capacities for self-control and self-regulation as leading them to internalise adult norms and standards; parents foster close emotional ties rather than imposing their authority (Hess et al., 1986; Lewis 1993). Cultural assumptions, which see children as intentionally good, support adults' non-authoritarian attitudes (Lewis, 1993; Yamamura, 1986). The benefits of these attitudes have been reported. Children are more likely to internalise rules in conditions where external pressure to obey these rules is weak (Lepper, 1981), while teaching attitudes using emotional authority have been reported to affect 5th graders' academic development negatively (Holloway, 1990).

The results of FIMS (First International Mathematics Study) in 1964 (Husen, 1967) reported that Japanese 13-year-olds scored higher on statements suggesting that they enjoyed schoolwork than children from other countries. Their attitudes were positively correlated with mathematics test performance ($r= .55$). The Minneapolis-Sendai Study (Stevenson, 1983) reported that Japanese children also had positive attitudes towards homework. However, pupils' motivation seems to have moved from an internal to an external orientation in the last three decades. The results of TIMSS (Third International Mathematics and Science Study) in 1994 showed that junior high school students' motivation was becoming highly extrinsic, and they learned mathematics for the sake of success in the senior high school entrance examination. Japanese children's perception of their efficacy in controlling the environment, as reported in previous research, is mixed. The results of FIMS (Husen, 1967) showed that Japanese students, overall, perceived that human beings had effective control of and mastery over their environment. In contrast, Weisz et al's (1984) study reported that the Japanese valued accommodating to existing realities rather than influencing realities, because they believed that external factors such as fate and luck were influential. Although these studies are somewhat dated, they suggest that attitudes might have changed between the 1960s and 1980s.

Deci et al. (1981) found that the pupils' perceptions of teachers' attitudes and classroom climate affected the way the pupils perceived inputs. Teachers who encourage pupils' autonomy give children information through competence feedback; as a result, pupils' intrinsic motivation, self-esteem and perception of their competence are promoted. Teachers who attempt to control pupils' behaviour, feelings and beliefs give rewards and communicate in such a way that controlling aspects are emphasised. In this case, pupils' extrinsic motivation might be promoted, but intrinsic motivation might be undermined. Deci et al. (1982) found that teachers' attitudes became more controlling when the teachers had to deal with administrators' strict control, excessive parental demands and pupils' poor behaviours.

Kage (1990) found that the methods of evaluation affected pupils' perceived competence, and their intrinsic motivation at Japanese schools as well. Lessons adopting criterion-referenced evaluation increased pupils' intrinsic motivation and perceived competence. Lessons adopting norm-referenced evaluation decreased their perceived competence, and as a result, increased pupils' feelings of tension and anxiety. Lessons adopting self-evaluation were not as effective as lessons adopting criterion-referenced evaluation, due to the absence of information about pupils' competence.

Deci (1992) also suggested that individuals have enduring individual differences in their ways of understanding and orienting to inputs. Individuals who value autonomy strive towards self-actualisation. Individuals who feel controlled tend to be conscious about how others see them. Individuals who experience incompetence are likely to develop self-derogation, depression, social anxiety and an external locus of control. De Charms (1968) differentiated between *'origins'* and *'pawns',* although this distinction is continuous, not discrete. *Origins* have strong feelings of personal causation about making changes in their environments, set realistic goals for themselves, engage in activities on which they put value, possess positive expectations for outcomes and take responsibility for their behaviour. In contrast, *pawns* typically have feelings of powerlessness and ineffectiveness, perceive situations as threatening, and exhibit task avoidance, because of a low perception of personal causation. Pupils' origin behaviour can be fostered through training teachers so that they enhance pupils' academic motivation, help student to set up realistic goals, and encourage students to take personal responsibility (de Charms, 1976; 1984).

There has been some research suggesting such individual differences among Japanese children. For instance, Nakayama (1989) reported that Japanese 6th graders who were conscious about social relationships in a class and those who were interested in the task had different learning styles. Pupils who had both high social and task orientation favoured receiving more direction and information from the teacher. Task-oriented pupils favoured self-reliance and self-decision, while socially oriented pupils relied on information from the teacher. Those who had both low social and task orientation perceived that they received less information.

Lepper et al. (1989) proposed that learning activities and materials could promote pupils' intrinsic motivation. They mentioned that learning activities and materials containing challenge, curiosity and fantasy, can promote the individuals' intrinsic motivation. Challenge informs the learners of the need to improve their competence, and in turn, raises self-efficacy and perceived control over outcomes. Curiosity, which is elicited by the incongruity between the learners' current knowledge or beliefs and task content, encourages learners to seek information and internalises new knowledge or beliefs into mental schemata. Fantasy can enhance perceived task value. Greater interest in activities promotes the learners' attention to relevant features of the learning context and increasing cognitive effort in the learning activity, which in turn, produces better learning.

Taken together this research suggests that pupils' perceptions of their competence and internal perception of control (autonomy) determine the extent to which pupils enjoy learning, i.e. intrinsic motivation. Pupils' perceptions of their competence and autonomy are believed to be cultivated through the internalisation of independence and mastery goals. Pupils' intrinsic motivation seems to be affected by environmental factors.

Provision of competence feedback rather than controlling feedback, the introduction of criterion-referenced evaluation rather than norm-referenced evaluation. Preparing learning activities and materials containing challenge, curiosity and fantasy, are also assumed to promote individuals' intrinsic motivation. Japanese culture values children's intrinsic motivation, autonomy and self-reliance in learning, although research has shown that children's motivation to learn mathematics is largely extrinsic rather than intrinsic.

Pupils' motivation

The Ministry of Education in Japan (1999) has proposed that a reduction in curriculum content and ensuring pupils' understanding of the content will promote pupils' motivation to learn mathematics. This strategy is supported by many theories, which propose that the optimal level of difficulty of the task is important in promoting learners' motivation. Lewin et al.'s (1944) valence theory postulated that individuals initiate their actions when the positive valence of success multiplied by the potency of success exceeds the negative valence of failure multiplied by potency of failure. They proposed that individuals relate the positive valence of success to task difficulty, which is assumed to be related inversely to the subjective probability of success. Atkinson (1964) developed Lewin et al.'s (1944) model and proposed that the resultant motivation is determined by the relative strength of motivation to seek success and motivation to avoid failure. The strength of motivation to approach success is decided by *achievement motives*, which are the individuals' dispositions hoping for or anticipating success, *the probability of success at the task* and *the incentive value of success.* The *incentive value of success* is an affect, specifically, pride in accomplishment, and has a positive relationships to task difficulty inferred from the *subjective probability of success* in an inverse relationship. On the other hand, the strength of motivation to avoid failure consists of the *motives to avoid failure*, which are individuals' dispositions to fear experiencing failure, the *probability of failure at the task*, and *the incentive value of failure*. An optimal challenge is perceived as promoting learners' motivation in Atkinson's (1964) theory.

Atkinson's (1964) model includes motives which are altered by individual dispositional tendencies towards success and failure, so that the resultant motivation is rather subjective. Atkinson (1964, 1966) found that people with strong achievement motives tended to set their level of aspiration at an intermediate level where there was moderate risk. People who had strong avoidance motives, greater than their achievement motives, tended to choose either the easiest or the most difficult task and avoided choosing the optimal level of task so that they could minimise the expected pain of failure. In contrast, Eccles et al.'s (1983) expectancy-task value model proposed that task value is positively correlated with expectancy. In addition, Eccles et al.'s (1983) model does not include the stable and enduring personality constructs of motives. While Eccles et al's (1983) model proposed that task value is positively correlated with expectancy, Atkinson's (1964, 1966) model proposed that it is positively correlated with task difficulty. However, the optimal level of the task could motivate the person to initiate action in both models.

The optimal level of task has also been perceived as contributing to people' affective attitudes. Harter's (1974, 1978, 1981) 'intrinsic motivation' model added optimal challenge as a determinant of intrinsic pleasure. Harter (1974, 1978, 1981) developed White's (1959) 'effectance motivation' model, which postulates that only success determined intrinsic motivation. Harter et al. (1984) suggested that children are most likely to have perception of their competence through success in optimally challenging activities. Piaget (1977) in his equilibration model suggested that optimal challenges, which contain information relevant to structures already stored and mastered but are discrepant enough to generate accommodation, promote children's feelings of competence or interest. Csikszentmihalyi (1985) postulated that the concept of flow, i.e. the situation where the individual feels total involvement in the activity combining positive affect and activation (Csikszentmihalyi, 1982) where there is the equilibrium between the individuals' perceived action opportunities (challenge) and action capabilities (skill). Lack of action opportunities compared to action capabilities may produce boredom, while excess action opportunities may cause anxiety; in both situations, motivation decreases. This seems to be the case for children. Danner et al. (1981) showed that children felt the most interesting tasks were one step ahead of their pre-tested skill level. Japanese mathematics textbooks are reported as systematising mathematics learning into a step-by-step procedure (Duke, 1986), which reflects this need.

The Ministry of Education in Japan (1999) has proposed that informing pupils of the meaning and purpose of learning mathematics will also motivate them to learn mathematics. What do the theories suggest can increase the value of the task? Eccles et al. (1983) emphasised the effect of achievement values on people's motivation. They proposed four major components of achievement values: attainment value or importance, intrinsic value, utility value and cost. Attainment value is defined as the importance of doing well or being involved in the activity. Intrinsic value is the enjoyment gained from doing the task. As Wigfield et al. (1992) point out, this intrinsic value is similar to intrinsic motivation as defined by Deci et al. (1975) and Harter (1981). Utility value refers to how a task fits into an individual's short and long-term future plans. Cost has to do with the negative aspects of doing a task, such as time-constraints. The evidence has shown that the value students put on learning mathematics predicts children's intentions and actual decisions to take mathematics courses more strongly than their expectations for success (Eccles, 1984; Meece et al., 1990).

5th graders are reported to have differentiated components within task value (Eccles et al., 1991). Eccles et al. (1989) showed that the basic structure of task value was not different between early adolescents and middle adolescents. However, Wigfield et al. (1989) showed that intrinsic value affected the intention to take mathematics in junior high school students, but utility value had less influence on their choice of task until senior high school level. Wigfield et al. (1992) argues that children's attempts at a task based on their interest in the activity do not link with their performance, which is assumed to link with their expectancy. The results of TIMSS in 1994 showed that the majority of 8th graders responded that they learned mathematics to pass entrance examinations in both Japan and the USA. Utility value in mathematics learning was important for them. Pupils appear to become ready to learn mathematics for extrinsic goals at an earlier age than Wigfield et al. (1989) proposed, although the TIMSS results did not examine whether pupils' utility value was reflected in their choice of mathematics classes.

Taken together, this research suggests that providing pupils with tasks at an optimal level of difficulty and informing pupils of the meaning and purpose of learning mathematics will promote pupils' motivation to learn mathematics. Pupils' valuing of learning is assumed to consist of several factors such as attainment value, intrinsic value, utility value and cost. The relationship between these may change over time. Pupils' valuing of learning may be affected by external factors such as features of the assessment system.

Pupils' sense of security

For the purpose of this thesis, pupils' lack of sense of security is interpreted as anxiety. The literature considered therefore relates to pupils' anxiety in learning. Pupils' anxiety can have either a facilitating or debilitating role on an individuals' performance (Yerkes et al., 1908, cited in Whitman, 1985). The Yerkes-Dodson Law assumes that optimal performance results from moderate levels of arousal. Too low levels result in a lack of concentration; too high interfere with processing. However, these effects are mediated by the difficulty of the task and the individual's sensibility to arousal levels. For instance, Chapin (1989) found that anxiety facilitated the academic performance of high anxiety, high performance students but debilitated high anxiety, low performance students.

Some literature proposes that anxiety is not a single dimension, but rather consists of several distinctive dimensions. Liebert et al. (1967) postulated two components of anxiety: the cognitive (worry) component and the motivational-arousal component. The cognitive (worry) component is associated with negative task expectations and negative self-evaluations towards the task. The motivational-arousal component involves fluctuation in the level of psychological functioning and negative feelings such as uneasiness, tension, and nervousness. Some literature shows that there is both a trait of test anxiety, which ascribes anxiety to a stable trait-like individual difference, and a state of test anxiety, which ascribes anxiety to specific factors across situations. A highly trait-anxious person is likely to experience state-anxiety more severely and in a broader range of situations than less trait-anxious persons (see Covington, 1992). State anxiety was believed as being more predictive of task performance than trait anxiety (Cattell et al., 1966; Spielberger, 1972), but Eysenck (1979) emphasised the negative effect of an individuals' trait-like anxiety on motivation and task performance. Eysenck (1979) argued that the motivational component of anxiety enhanced the quality of performance by inducing increased effort and attention when the probability of success was high. However, high-anxiety individuals tended to set difficult goals, which reduced the probability of success, and as a result, tended to lessen motivation.

Dreger et al. (1957) defined mathematics anxiety as a 'syndrome of emotional reaction to arithmetic and mathematics'. Richardson et al. (1972) defined mathematics anxiety as 'feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide range and variety of ordinary life and academic situations'. Mathematics anxiety is a widely acknowledged phenomenon and may lead to mathematics avoidance and math-phobia, which is sometimes passed on to the next generation through parents and teachers (Buxton.1981; Lazarus, 1974; Bulmahn et al, 1982; Kelly et al., 1985; Larson, 1983). Bibby (1999) reported that many primary teachers maintained their negative affective attitudes towards mathematics such as lack of confidence, formed through their experiences in mathematics classes in their younger days, although they might have their confidence restored through the opportunities. The Cockcroft report (1983) in the UK, noted that an individual's arithmetical confidence was not connected with actual competence as indicated by educational qualifications or occupation as did Bibby's (1999) report. This suggests that emotional responses are not learned in relation to mathematics performance and are probably related to interactions with teachers and other pupils. Several distinctive dimensions have also been found in children's mathematics anxiety. Ho et al. (2000) found distinct cognitive and affective aspects of mathematics anxiety among 6th graders, across countries which had different cultural backgrounds. Suinn et al. (1989) established the Mathematics Rating Scale for Elementary School Students (MARS-E) and found that 4th–to 6th graders appeared to have two factors of mathematics anxiety: test anxiety and mathematics performance evaluation anxiety.

Some research has found mathematics anxiety among Japanese students as well. Fujii (1994) reported that university students' mathematics anxiety was influenced by their experience of mathematics learning in their earlier days. Students' earlier experience of difficulty in mathematics learning and dislike of mathematics was positively correlated with mathematics anxiety, while their commitment and time spent on mathematics learning and familiarity with numbers and shapes in elementary school days were negatively correlated with mathematics anxiety.

The Ministry of Education in Japan (1999) believes that pupils' anxiety arises from their experiences of task difficulties and their relationships with the teacher and peers. This is supported by recent research. Newstead (1998) found that children might experience anxiety related to the social or public aspects of doing mathematics, and teaching style might affect these. Pupils learning in classrooms where teacher demonstration and individual practice was the norm disliked mathematics significantly more, and felt more anxiety in relation to social aspects, such as interactions, than the pupils in the classroom where solving non-routine problems and discussing strategies in small groups were of primary importance. No significant difference between these classrooms was found in the pupils' task-oriented anxiety.

Wigfield et al. (1989) reported that students' anxiety in learning was increased by features of classroom atmosphere, for instance, strict, salient and normative evaluation systems and overly high standards for evaluations. Similar findings have been reported in Japanese classrooms. Satake et al. (1995) found that 6^{th} graders were more likely to experience classroom performance anxiety than 5^{th} graders. Higher achievers at both grades were more likely to experience classroom performance anxiety than lower achievers. The researchers suggested that teachers' higher expectancies and demands of high achievers produced higher classroom performance anxiety in pupils. Isoda's (2000) study found that even 8^{th} graders who enjoyed mathematics had a high heart beat rate when they tried to explain their thinking in class.

Taken together this research suggests that pupils' anxiety about learning mathematics, which may cause their performance to deteriorate, occurs because of situation-specific factors and the individual's reactions to them. As these responses are learned, providing an appropriate supportive learning environment can reduce anxiety. Reducing difficulties in the curriculum, promoting positive relationships in a class, and avoiding an excessively strict and normative evaluation system may be effective measures to prevent pupils from developing mathematics anxiety.

Pupils' sense of progress

The Ministry of Education in Japan (1999) has defined the acquisition and consolidation of fundamental knowledge and skills as one of the aims of mathematics education. The ministry believes that pupils can have a sense of fulfilment through the acquisition and consolidation of fundamental knowledge and skills, and that this can enhance pupils' interest in mathematics learning and motivation. However, pupils' level of knowledge and skills is not necessarily linked to their perception of their competence and self-efficacy. For instance, the research results in TIMSS showed that Japanese 8^{th} graders had relatively low levels of confidence and relatively low self-efficacy in mathematics learning, despite their relatively good performance.

Bandura (1997) explains that children can have different perceptions of their competence in relation to similar attainment because individuals have different interpretation, storage, and recall of failure and success, and society has different influences on individuals' processes of assessing their own capabilities. The Big Fish Little Pond Effect (Marsh et al, 1984), whereby student's academic self-concept is not determined by their actual academic attainment but by relative comparison with other students in school supports these social influences which Bandura (1997) has suggested.

Bandura (1997) suggested that efficacy beliefs are a driving force, which brings cognitive skills to actual performance through motivational and other self-regulatory skills. Schunk (1989) found that pupils' efficacy beliefs had a greater power of prediction relating to their intellectual performance than their acquired skills. Pintrich (1996) suggests that self-efficacy interacts with observed goal progress and in turn, sustains motivation and improves skills. Therefore, the promotion of pupils' perceptions of their competence and self-efficacy must be studied separately from their level of knowledge and skills in mathematics.

How do children form perceptions of their competence and self-efficacy? Harter's (1981) 'effectance motivation' model proposed that individuals have an intuitive desire to master their environments and have efficacy in interaction with it. Perception of their competence in Harter's (1981) model is one determinant of effectance motivation. The existence of perception of their competence increases effectance motivation, while lack of perception of their competence is assumed to decrease such motivation. This research will be discussed in detail later in relation to self-perception.

Eccles et al.'s (1983) expectancy-task value model emphasises the social influence on these perceptions, which they term task specific-concepts. Children form task specific-concepts and perceptions of task difficulty based on the cultural milieu, socialisers' behaviours, past performance and events. These social and environmental factors also affect children's perceptions, interpretations and attributions of such social environments, and in turn, affect children's task specific self-concepts and task difficulty beliefs. Children's task specific-concepts and task difficulty beliefs form their task value and expectancy for success. Expectancy for success is conceived of as consisting of the child's ability perceptions, expectancies, and performance perceptions (Eccles et al., 1991). Expectancy for success is conceived as combining with task value to determine the individuals' motivational behaviour such as task choice, persistence, cognitive engagement, and actual performance. The positive effect of individuals' expectancy for success on their subsequent performance has been found in research on mathematics learning (Eccles, 1984; Meece et al., 1990).

Bandura's (1986) self-efficacy theory emphasises the individuals' capabilities within an interdependent causal structure involving triadic reciprocal causation with behaviour and environmental events. This theory defines self-efficacy as the belief in one's capabilities to organise and execute courses of action which require achieving given attainments in a specific situation. Personal commitment to the goal, especially to self-determined goals combined with challenge, develops a sense of personal efficacy, intrinsic motivation (Bandura et al. 1981) and the development of skills (Schunk, 1985).

Self-efficacy theory (Bandura, 1982, 1986, 1989, 1997) defines outcome expectancies as judgements or beliefs regarding the relation between a person's behaviour and the anticipated outcome. The anticipated outcome includes physical effects accompanying behaviour, the degree of social acceptance and positive or negative self-evaluations. Self-efficacy and outcome expectancies are orthogonal, although outcome expectancies are heavily dependent on efficacy judgement (Bandura, 1986). The combination of high self-efficacy and high outcome expectation is assumed to produce productive engagement, aspiration and personal satisfaction. The combination of high outcome expectation and low self-efficacy may lead the individual to self-devalue and become depressed. The combination of high self-efficacy but low outcome expectation may make the individual feel discriminated against within the environment. When both the individual's self-efficacy and outcome expectations are low, the individual may feel resignation, apathy and withdrawal (Bandura, 1982).

Fujiu (1992) examined the relationships between pupils' feelings of self-efficacy and outcome expectancy, reflected in raising their hands in a class. He found that students needed to feel self-efficacious to have confidence in raising their hands in response to difficult questions. In contrast, to raise their hands for easy questions, they needed appropriate outcome expectancy such as their peers' acceptance and an outcome-value such as the value of responding. This study suggests that promoting pupils' self-efficacy by promoting their understanding of the curriculum and promoting pupils' outcome expectancy by arranging good relationships in a class to encourage pupils to be involved in mathematics classes positively may both be effective.

Pupils' perceptions of their competence and self-efficacy are subjective concepts affected by the individual's personality, personal history and environmental factors. These perceptions are conceived as influencing their motivation and the improvement of their performance more than their knowledge and skills. Teachers should attempt to ensure that pupils believe that they can manage the task and that their learning activities are worth doing, to set up optimal specific learning goals while valuing pupils' autonomy in learning, and to arrange the classroom ethos to support an individual child's performance outcomes. All these activities enhance pupils' perception of their competence and self-efficacy. These, in turn, enhance pupils' motivation and lead to better performance.

2.2: The relationships between pupils' enjoyment, motivation, sense of security and sense of progress

The relationships between pupils' enjoyment and motivation

The Ministry of Education in Japan (1999) emphasises promoting pupils' intrinsic motivation, as reflected in their belief that showing pupils that mathematics learning and developing mathematical ideas can be enjoyable, is important. The results of TIMSS showed that 91% of Japanese 8^{th} graders believed that getting high marks in mathematics tests is important in order to succeed in the entrance examination to senior high schools and university (National Institute for Educational Research, 1997). Thus, extrinsic motivation is very important for some school pupils. Some observers from other countries have seen the Japanese system of entrance examination as a strong motivator.

Lynn (1988) suggested that the Japanese entrance examination system provided junior high school students with specific goals, proximate sub-goals and challenging goals such as to promote motivation and achievement of almost all of the children, who wanted to proceed to senior high school. Lynn also suggested that the entrance examination system promoted students' motivation because it provided students with opportunities to co-operate to achieve the common objective within a group, and also with competition between groups. Johnson et al. (1983) has indicated that a situation containing both co-operation and competition facilitates the learners' motivation and achievement. However, there is a question as to whether learning mathematics for the entrance examination affects pupils' affective attitudes towards mathematics learning negatively.

Eccles's (1983) expectancy-task value model defined learning for short-or long-term goals, such as an entrance examination, as guided by extrinsic motivation and described it as "utility value". Utility value co-exists with three other task values: importance, intrinsic value and cost. The task value which the pupils emphasised more in their learning seemed to vary according to their age, but the task values did not exclude each other. Therefore, some pupils may find that learning mathematics and developing their mathematical ideas is enjoyable, while at the same time they try hard to learn mathematics for the entrance examination.

Some researchers have suggested that pupils' motivation to attain short-or long-term goals is different from extrinsic motivation, and produces better outcomes than extrinsic motivation. Harter (1992) found that intrinsic, extrinsic and internalised motivation were three independent constructs of motivational orientation among 6^{th}, 7^{th}, and 8^{th} graders. She suggested that internalised motivational behaviour was initially promoted by external rewards offered by socialising agents, but then occurred spontaneously through self-reward. Children with internalised motivational orientations were conceived as engaging in learning for short-or long-term goals. She found that students with high intrinsic and internalised motivation and low extrinsic motivation showed higher perceived competence, positive affect towards learning and higher teacher acceptance than students who were high in all three motivational orientations and students only whose extrinsic motivation was high. Students who were low in all three motivational orientations showed the lowest scores in all of the three domains. This research suggests that Japanese children's striving to learn mathematics for entrance examinations can be considered as affecting their perception of their competence and affective attitudes positively.

Deci et al.'s (1985) organismic integration theory notes that internalisation is the process which integrates external motivation into a unified system of structures and motives, so that the extrinsic regulation that is internalised will eventually be experienced as self-determined. Internalised regulation is observed as children grow older (Chandler et al., 1984). Internalisation makes children value or view task engagement as important (Chandler et al., 1984). Non-spontaneous behaviour is assumed to be internalised through four stages of regulation. External regulation occurs as a response to external cues. Introjected regulation occurs through self-monitoring without the presence of external cues. Identification is the stage when individuals accept the regulation as their own. Integrated self-regulation is the stage when individuals integrate self-regulation with other identification to unify the sense of self and experience and provide a full sense of self-determination. The more internalised one's extrinsic motivation, the more self-determination, self-esteem and perception of competence are enhanced and anxiety is decreased (Connell, et al., 1985; Deci, et al., 1985).

Deci et al's (1994) self-determination theory emphasised the influence of social contexts on motivation. They suggested that the social contexts that facilitate satisfaction through competence, autonomy, and relatedness to others - by providing optimal challenge, informational feedback, interpersonal involvement, and autonomy, support and promote both intrinsic motivation and self-determined forms of extrinsic motivation (also see Koestner et al., 1984; Deci, et al., 1985).

Deci et al's (1994) empirical study showed that internalisation in self-determination - supporting conditions was integrated, as reflected by positive correlations between behavioural self-regulation and affective variables such as the personal importance of the activity and enjoyment. On the other hand, internalisation, which occurred in more controlling conditions, was introjected, as reflected by negative correlations between behavioural self-regulation and the affective variables. Children are less likely to integrate regulation when they perceive that they are controlled by others (Connell, et al., 1985). Children whose motivation is introjected tend to be nervous in school and maladaptive when coping with failure, while children whose motivation is in the stage of identification tend to enjoy school and find positive ways of coping with failure (Ryan et al., 1989).

Bandura (1997) supports the notion of internalised motivation. He argues that, in social cognitive theory, the growth of intrinsic interest is fostered through affective, self-reactive and self-efficacy mechanisms. Behaviour, which is originally not its own reward, provides its own rewards once it becomes invested with personal significance. Once self-involvement in activities is tied to personal standards, variation in performance attainment activates self-reactions such as self-satisfaction or self-dissatisfaction. Individuals' affective reactions to their own performance provide a sense of fulfilment and create personal incentives for accomplishment, and constitute the principal source of reward.

Intrinsic and internalised motivation can co-exist and affect pupils' perception of their competence, self-esteem and affective attitudes towards mathematics learning positively. When pupils believe that learning mathematics is important, and when their attempts to learn mathematics are based on self-determination, learning mathematics for entrance examinations may produce better performance and affective attitudes than when pupils do not perceive the importance of learning mathematics and when autonomy in learning is not assured. Teachers need to avoid pupils feeling forced to learn mathematics. Providing optimal challenge, informational feedback, interpersonal involvement, and autonomy is important to promote pupils' intrinsic and internalised motivation.

The relationship between pupils' motivation and their perceptions of their own competence

The Ministry of Education in Japan (1999) has indicated that pupils come to enjoy learning mathematics more, and try harder to learn mathematics, as their perception of their own competence is enhanced. The literature supports this assumption. Children's task specific-concepts, in the model of Eccles et al.' (1983) are determinants of task value and expectancy for success, which in turn, contribute to pupils' motivational behaviour. Individuals' perception of their competence in Harter's (1981) model is one of the determinants of effectance motivation. Children who perceive that they are highly competent are more likely to have positive affect towards competence and to show intrinsic motivational behaviour such as mastery learning, curiosity and seeking challenge (Harter et al., 1984). Bandura (1997) argues that pupils' efficacy beliefs promote their motivation, and promoted motivation produces actions such as strategic thinking, and in turn, contributes to accomplishment (Bandura, et al., 1981; Collins, 1982; Bouffard-Bouchard, 1990; Bouffard-Bouchard, et al., 1991). Self-verbalisation of competence, and social feedback on competence (Pretty et al., 1984, Sagotsky et al., 1978) enhance pupils' efficacy beliefs, intrinsic motivation and interest.

Pupils' intrinsic motivation has been reported to affect their perceptions of their competence. Thus, pupils' motivation and those perceptions are mutually related. Children, who perceive autonomy in a classroom and are intrinsically motivated, tend to perceive themselves as having high competence and high self-esteem (Deci et al. 1981) and high achievement (Perlmutter et al., 1977; Sadowski et al., 1981). Controlling conditions reduce pupils' intrinsic motivation and lead to low-quality learning outcomes such as poor conceptual learning (Grolnick, et al., 1987), inflexible thinking (McGraw et al., 1979), and low levels of creativity (Amabile, 1983). Kage (1991, cited in Deci, 1994) found that Japanese junior high school students in a controlling evaluative condition expressed less interest in the material, rated themselves as less competent, and reported greater anxiety than students in an autonomy-supportive condition. Valuing pupils' autonomy is important to promote both motivation and perceptions of their own competence.

The relationship between pupils' enjoyment, motivation, sense of security and perception of their own competence

The Ministry of Education in Japan (1999) has suggested that when pupils perceive themselves as competent this not only promotes their motivation but also decreases their anxiety in mathematics learning. Harter's (1981) model postulates that students' sense of low competence and extrinsic motivation produces their anxiety. Meece et al. (1990) argue that the degree of pupils' anxiety in learning is determined by the effects of past successes and failures on the pupil's beliefs about their personal efficacy. Fennema et al. (1976) found a strong negative correlation (r= - .89) between mathematics anxiety and confidence scores. Bandura (1997) suggests that students' perceived low self-efficacy and their anxiety together reduce their performance, although the main cause of deterioration of performance is perceived as low self-efficacy (Pajares, et al., 1994), not anxiety itself (also see Pintrich, et al., 1990; Siegel et al, 1985).

Liebert et al. (1967) found a cognitive (worry) component and a motivational-arousal (emotional) component in anxiety. They found that worrying about test performance was negatively related to test performance, while emotionality was not related to this. Similarly, Harter et al. (1986, cited in Harter et al. 1992) argued that children's perception of their competence as low was found to relate to their worry about performance directly related to task engagement, but not to their emotional reactions. Kowalski (1984, cited in Harter, 1992) found that children who had high perception of their competence reported emotion such as pride at success or shame at failure. Students who reported self-affect on both success and failure had internalised motivation and cultivated intrinsic motivation, and in turn, their performance was enhanced. In contrast, children who perceived their competence as low reported emotion directly related to either outcomes or attributions for success and failure. These students depended much more on extrinsic motivation, particularly the avoidance of disapproval and sanctions. Their performance deteriorated.

Wigfield et al. (1988) found that pupils' anxiety was more than a lack of confidence in mathematics, rather it arose from negative affective reactions. Ho et al. (2000) found that affective factors measured by the Mathematics Anxiety Questionnaire (Wigfield et al., 1988) had a strong negative impact on mathematics achievement. Wigfield et al. (1988) found that the pupils who perceived their competence as low and were concerned about the possible consequences of failure had low performance, while pupils who had high expectations for success valued mathematics learning and put effort into it. Thus, Wigfield et al. (1988) also support the negative relationships between individuals' perception of their competence and anxiety. Taken together this research suggests that pupils' perceived competence, intrinsic motivation and sense of security are related. Pupils are assumed to show high performance when these aspects are high, while pupils are likely to show lower performance when these aspects are low.

2.3: Developmental differences in pupils' attitudes towards learning

The previous section indicated that Japanese students show lower intrinsic motivation, perception of competence and confidence, and stronger anxiety, as their grades proceed. Some of the literature has reported that junior high school students in other countries show similar development in learning mathematics. For example, Wigfield, et al. (1994) showed that pupils' self-esteem, competence beliefs, interest and sense of the utility and importance of learning mathematics decreased dramatically at transition from elementary schools to junior high schools. Harter (1981, 1992) showed that this transition negatively affected students' intrinsic motivation, and that their anxiety increased. Such negative effects of transition were found irrespective of students' prior attainment (Harter, 1992), although Eccles (1993) showed that lower achievers were reported as more vulnerable in transition.

The deterioration in older children's perception of their own competence is often explained in terms of developmental changes in self-perception. Older children's greater competence in making comparisons with others, and their entity-like perceptions of intelligence, are assumed to weaken their views of their own competence (Wigfield, et al., 1994). However, research on children's self-concept has found that developmental change in children's self-perceptions may occur earlier than Wigfield, et al. (1994) suggested. Marsh (Marsh et al., 1984; Marsh, 1985, 1986 and Marsh, 1989a) reported empirical research using his Self-Description Questionnaire which showed that self-concept declined during the middle and late stages of elementary school. Marsh et al. (1985) found that recovery of self-esteem occurred after the junior high school age. Other researchers have found that self-concepts were stable (Trowbridge, 1972), or became more positive (McCarthy et al, 1982; Connell et al., 1975), during the junior high school years.

Harter (1981, 1982) found that the decrease in children's perception of their own competence at 7th grade was due to their feelings of uncertainty concerning whether they could control their learning by themselves, and their uncertainty about their competence. Harter (1982) found that the consistency between children's perception of their own cognitive competence and their actual achievement was likely to improve as they proceeded through their grades during elementary school, but dropped dramatically at 7^{th} grade. Similarly, children's perception of their own cognitive competence and the teachers' judgement of their pupils' cognitive competence became more consistent as they proceeded through the grades, but at 7^{th} grade, this consistency dropped dramatically. These drops were later reversed. Pupils' decreased perception of their own competence made them vulnerable to environments which promoted extrinsic motivation and increased anxiety (Harter, 1992).

Wigfield et al. (1994) have suggested that negative motivational consequences might be due to environmental factors. They proposed that the environment of junior high schools lacked 'stage-environmental fit' to the developmental needs of adolescents. Children are also likely to have developed their mastery attempts by the late stage of elementary schools (Harter, 1978). Children, who were previously dependent on external cognitive-formational structures such as the teachers' opinion or judgement and external sources of evaluation, are more likely to have an internal sense of judgement (Harter, 1981). Peer evaluations are a more important tool for junior high school students than for elementary school students, and internalise others' opinions about the self (Rosenberg, 1979). The nature of school and classroom environments becomes more competitive, evaluative and controlling (Wigfield et al., 1994). Teachers increase their control of their students, and the quality of teacher/student relationships decline after 7^{th} grade (Eccles, 1993). Such environments affected low-achievers more negatively (Eccles, 1993).

Harter (1986) also suggested that there were negative effects of environmental factors in junior high school on pupils' motivation. Environmental factors such as strict evaluation and salient social comparison diminished the children's intrinsic motivation and their motivational actions. Children who perceived their competence as low were more likely to be vulnerable to a new environment after transition (Harter, 1992). In contrast, students who perceived their competence as high were more likely to have positive affect, putting value on success, than children with low perception of their competence (Harter, 1992). Bandura (1997) emphasised the effects of pupils' sense of their own efficacy on the transition to junior high school. He suggested that the transition to junior high school did not necessarily affect all students' motivation and emotion; this is because students' sense of efficacy mediates the impact of the transition (Bandura, 1997).

Overall, children's intrinsic motivation and perceptions of their own competence decreases and their anxiety increases as they proceed through the grade. This is a phenomenon not only found in Japan. Although pupils' developmental changes, such as their greater competence in making social comparisons and their entity-like perceptions of intelligence, might impact on pupils' affective attitudes negatively, environmental factors have also been reported as the cause of the deterioration of pupils' affective attitudes. Rigorous evaluations and salient social comparisons decrease pupils' perception of their own competence and internal perceptions of control, and in turn, encourage pupils' extrinsic motivation and increase anxiety. Children with low perception of their competence are particularly vulnerable to the effects of their environment.

2.4: The factors believed to affect pupils' attitudes towards learning

Pupils' perceptions of the self

Research on self-perceptions of competence have examined individuals' self-concept in the academic domain in relation to other aspects of self-concept, general self-concept and self-esteem. James (1890) proposed that self-esteem, the global affective reaction or evaluation of oneself, is the ratio between individuals' 'successes' (*self-image*) and 'pretensions' (*ideal self*). Harter (1986) found that 5th through 7th graders with high self-esteem showed much less discrepancy between their individual value for the task and their perceptions of their own competence to manage it, than students with low self-esteem. Individuals tend to give importance to areas where they consider themselves to be good, to protect their self-esteem (Rosenberg, 1965, 1979, and 1985). Thus, pupils who perceive their competence in mathematics learning as low are unlikely to put value on mathematics learning, in order to maintain their high self-esteem.

Shavelson et al. (1976) defined self-concept as a person's self-perceptions, formed through experience with and interpretation of one's environment. It is particularly influenced by the evaluations of significant others, reinforcement, and attributions for one's own behaviour and accomplishment. The model has a hierarchical structure, where general self-concept appears at the apex of the hierarchical model, and is divided into academic and non-academic components of self. Marsh's (1990) 'self-perceptions of competence' research is based on Shavelson et al.'s (1976) model of self-concept.

Marsh's (1986b, 1990) self-perceptions of competence has a multidimensional structure that becomes increasingly multifaceted with age. In this model, the mathematics concept is located within the academic components of self. Marsh (1986b, 1990) has shown that verbal and mathematics self-concepts are nearly uncorrelated with each other, and have quite distinct relationships to verbal and mathematics achievement scores. Marsh (1989) suggested that 5th graders have already formed perceptions of their own competence in different school subjects, which become further differentiated during preadolescence.

Harter (1982) proposes that general self-worth is an independent factor, separate from any skill domain. Perception of competence is conceived as one type of lower-order evaluative dimension under a superordinate construct such as self-esteem or self-worth. In contrast to Marsh's formation, pupils' perception of their competence in Harter's (1982) Perception of their Competence Scale for Children consists of three domains: cognitive, social, and physical competence. Harter's (1982) empirical study with 3rd - 9th graders showed that such a factor structure remained stable across the grade levels. Harter (1985) proposed that self-esteem is an affective or emotional reaction to the self, while self-perception of competence is a cognitive appraisal or belief about the self in a specific domain. Both Harter (1985a, 1986) and Marsh (Marsh, et al., 1984; Marsh, et al., 1985) have shown that global self-esteem and self-perceptions of competence are correlated but empirically separate dimensions.

Hazel et al. (1991) proposed that the Japanese perception of self is an interdependent view of self. The interdependent view of self is a fluid concept, which varies according to social contexts and relationships with others. It is different from the independent view of self where individuals' wholeness and uniqueness are valued. The individual as interdependent self attempts to complete self-representations through sharing goals in relationship with specific others in particular contexts, rather than seeing others in terms of social comparison and self-validation (Hazel et al., 1991; Kiefer, 1970). Japanese children are encouraged to find commonality with rather than difference from peers (Wray, 1999; Crystal et al., 1998).

Befu (1986) postulates that Japanese culture thinks of the self in terms of commitment to the individual role (role perfectionism) based on individual effort, and exhortation (self-discipline) in the context of connections with others (interpersonalism). Singleton (1991) described how a child is expected to accomplish a given role in a group. The promotion of co-operation and interpersonal skills is encouraged in classrooms to develop a sense of pride in effort as a group member (Lewis, 1995a.b). Lynn's (1988) study mentioned above, reports that the entrance examination system encourages students to co-operate to achieve a common goal and promotes pupils' motivation based on Japanese children's interdependent view of self. Some studies (e.g. Zander 1983) have shown that the Japanese can raise their self-esteem and are motivated more when they know that their effort will contribute to their group rather than to personal accomplishment. This is in contrast to the Americans who work for their personal good. While some perceive that individuality is sacrificed to group cohesiveness in Japan (Stevenson, et al. 1992a), others see that co-operation is the appropriate way of expressing and enhancing the self in Japanese cultural contexts where the self is considered in relation to harmony in human relationships (White, 1986).

Hazel et al. (1991) proposed that in Japan children were striving to achieve the goals of family and teachers with whom they are reciprocally interdependent. Samimy et al. (1994) postulated that Japanese children's perseverance in learning is formed through mothers' unconditional love (*amae*) and a reciprocal obligation towards such mothers' love (*giri*). Japanese 5th graders believed that learning mathematics was important for themselves, but at the same time, they felt good about pleasing their teachers and parents by good performance. For them, external reasons for good performance were not reward and punishment, as in the case of American children (Hamilton, 1989). Stenlund (1995) reported that Japanese teachers felt encouraged by student enthusiasm and responsiveness, the emotional bond between students and teachers and seeing the growth and development of students, while they felt discouraged by shared-blame problems such as poor student-teacher communication. Iwai (1986) showed that good relationships with peers and family members, and satisfaction with mathematics performance, seemed to affect Japanese 7th and 8th graders' self-esteem more than self-assessed and teacher-assessed mathematics performance. However, the results of TIMSS showed that the majority of 8th graders expressed their disagreement with the statement that they were trying to get higher marks to make their parents happy.

Although the self-concept of Japanese students, especially younger children, has rarely been studied, such research as there is has reported that the general self-concept of

Japanese participants is lower than that of students from other cultural backgrounds (Bornstein, et al. 1998). A low degree of self-confidence can be seen even among elementary-school children (Prime Minister's Office, 1979). Bornstein, et al. (1998) proposed that Japanese students' low self-concept might be due to a cultural background which values humility as opposed to self-confidence and avoids self-assurance. Hess et al. (1986) found that Japanese mothers of pre-schoolers encourage compliance, politeness and emotional maturity rather than social skills with peers and verbal assertiveness.

Overall, these research findings indicate that conceptions of perceived self have cultural differences. The independent view of self found in Western culture values individuals' wholeness and uniqueness, aiming to actualise the ideal self. In this case, the degree of pupils' personal value for a task such as learning mathematics is mutually related to their self-esteem. In contrast, the self-concept of Japanese participants is an interdependent view of self, and is formed in relationship with particular others in specific contexts. Although some research has reported that Japanese students' self-concept is low compared to the independent view of self, good relationships with peers, the teacher and family member may have a positive effect on Japanese pupils' self-esteem and promote their motivation.

Classroom atmosphere and pupils' attitudes towards learning

The evidence suggests that pupils' perceptions of classroom atmosphere affect their attitudes towards learning. Fraser (1986) identified five aspects of classroom atmosphere as affecting pupils' learning outcomes: satisfaction, cohesiveness, difficulty, friction and competitiveness. His synthesis of the effects of classroom ethos on pupils' learning outcomes indicated that satisfaction in classes is positively related with pupils' attainments, while difficulties and friction in the classes are negatively related (Fraser, et al., 1982a, 1982b). The relationship between cohesiveness and pupils' attainments is unclear, while competitiveness among pupils in the classroom can produce unfavourable outcomes. His synthesis has not considered the effects of classroom ethos on pupils' affective attitudes to learning.

Johnson et al. reviewed the effects of pupils' perceptions of classroom ethos on their affective attitudes. A review of this research (Johnson et al., 1974) corroborated that co-operative grouping promoted intrinsic motivation in that it led to less anxiety, greater task-involvement, and more positive emotional tone than did competition (e.g. Haines et al., 1967; Phillips et al., 1956). Co-operative learning styles promoted pupils' self-esteem, high academic self concept and good interpersonal relations more than competitive and individualistic learning (Johnson, et al. 1993; Johnson et al, 1999). Children preferred school to be based on co-operation (Johnson, et al., 1976; Johnson, 1976; Johnson, et al., 1973).

Shwalb et al. (1985a.b) studied Japanese children's perceptions of co-operation and competition in the classroom. Their study suggested that although females are more co-operative and males are more competitive in orientation, both genders preferred co-operation to competition. The findings suggested that children formed a positive and stable attitude towards co-operation prior to the 5th grade, while their perceptions of competition moved from general factors to distinctive factors as they grew older. Shwalb et al (1995) reported that group competition was rated more positively than competition between individuals. For instance, Lynn (1988) suggested that entrance examinations can be motivators for both teachers and pupils, because competition occurs between schools, rather than between individual pupils, although some have observed that there is some friction due to the competition for entrance examination in junior high school (Mochizuki, 1993) and have been worried about the negative effect of competition due to entrance examinations on pupils' affective attitudes (Azuma, 1986). Shwalb et al. (1985a.b) found that Japanese teachers believed that students' co-operation and competition was manifested in different styles according to their developmental stage. Elementary school children experience co-operation and competition in a group. For instance, friendliness, harmony and concern with peers' work were frequently observed features of co-operation, and seeking teachers' attention, being first and fast and being in the best group were frequently observed features of competition found at elementary school. Both co-operation and competition became personal and individual at junior high school. Sharing problems with peers was the most distinct feature of co-operation, and self-assertion and individual striving were the distinct features of competition at junior high school. Teachers up to high school level in their study did not perceive competition in examinations and grades as a distinctive feature of competition.

The research discussed in this section indicates that pupils' perceptions of classroom ethos can affect students' affective attitudes in learning. Age and cultural difference seem to affect pupils' perceptions of classroom ethos. Japanese children seem to prefer co-operation to competition. They seem to prefer competition between groups rather than competition between individuals. This seems especially the case for elementary school children, who are likely to experience both co-operation and competition in a group. Features of co-operation and competition seem to become more personal and individual at junior high school.

Pupils' motivational orientation and attitudes towards learning

Harter et al. (1984) showed that understanding the reasons for learning outcomes was important for pupils' academic performance and attitudes towards learning. Children who understood the reasons for their learning outcomes were likely to ascribe them to internal causes and achieve highly, and have higher perceived competence, positive affect towards learning, intrinsic motivational behaviour and intrinsic judgement regarding their learning than children who did not know the reasons for their learning outcomes. Understanding the reasons for their performance is particularly important for junior high school students, who come to have a more integrated network of constructs across cognition, affect, motivation, and behavioural orientation.

Weiner et al. (1979) suggested that achievement-related affect was divided into two; affect arising from the outcomes such as pleasure and disappointment, and affect depending on individuals' attributional styles. They found that individuals tended to have a habitual way of explaining events that was a personal cognitive characteristic. These stable individual differences mean that individuals tend to have a stable attribution style across situations. Weiner et al. (1971, 1979, 1986, and 1992) analysed attribution in terms of logical and empirical analysis, and proposed an 8-dimension classification consisting of internal-external, stable-unstable and controllable-uncontrollable dimensions. Current attribution research defines attributions based on ability, effort, task difficulty and luck, but also more diverse attributions such as intrinsic motivation and teacher's competence (Pintrich, 1996; Weiner, 1986).

Weiner (1986, 1992) proposed that the stability dimension of attribution induced expectancy change, the locus dimension induced esteem-related affects, and the control dimension induced social-related affects. Ascribing failure to unstable factors such as lack of effort produces positive outcome expectancy, while ascribing it to stable factors such as lack of ability reduces learners' outcome expectancy. Ascribing positive learning outcomes to external causes, and negative learning outcomes to internal causes, would decrease self-esteem and academic self-concepts. Ascribing negative learning outcomes to controllable factors such as lack of effort produces guilt, while ascribing them to uncontrollable factors such as lack of ability produces shame. In short, ascribing negative outcomes to lack of effort provides individuals with an expectancy for future success and enables lowered self-esteem to recover. Consequently, these effects often promote motivational activation and approach behaviour. On the other hand, ascribing negative outcomes to lack of ability provides the individual with a low possibility of future success and hence decreased self-esteem is less likely to recover. As a result, the person feels submissive, inferior and helpless, giving rise to withdrawal and motivational inhibition.

"Learned helplessness" theory proposes that some individuals attribute failure to stable factors and have low outcome expectancy (Abramson, et al.1978; Peterson et al. 1993). Marsh (1984) and Nicholls (1979) have also suggested that ascribing failure to lack of ability has negative effects on academic self-concept. However, it has been reported that pupils' attributional styles may be altered by training. Schunk (1983) reported that altering children's attributional styles, so they could attribute their success to ability, improved their mathematics self-efficacy and achievement, while Dweck (1975) reported that encouraging children to attribute their failure to effort improved their attitudes and performance.

Individuals tend to make biased attributions to maintain their self-esteem; this is called "self-serving bias". Individuals tend to take personal responsibility for successful outcomes (*a self-enhancing bias*) and deny responsibility for failure outcomes (*a self-protective bias*). Some individuals tend to take responsibility for an outcome, regardless of actual success or failure. This tendency is called the "self-centred bias" (Pintrich, 1996). In addition, some individuals come to see their behaviour or attitude as typical, and to maintain their beliefs so as to preserve their self-esteem. This tendency is called the "false consensus effect" (Fiske et al., 1991). Age differences have been found in individuals' self-serving bias, probably because children's attributional styles move from external to internal as they grow up. Skaalvik (1990) reported that Norwegian 6th graders who attributed their poor performance to external causes had higher self-esteem than those attributing it to internal causes. For 9th graders, attributing their poor performance to lack of effort maintained high self-esteem.

The attribution of causes for others' achievements has also been explained. Ascribing others' negative outcomes to uncontrollable aspects produced sympathy, while ascribing others' negative outcomes to controllable aspects produced anger. Sympathy prompted people to help, anger led people to neglect to offer help to the person in need. Weiner et al. (1970, 1986) indicated that success due to effort in spite of lack of ability was assumed most likely to deserve rewards, while failure because of lack of effort in spite of possession of ability was assumed most likely to deserve punishment. Stahelski et al. (1987) indicated that sympathy and pity dominated ratings when failure was paired with low ability and high effort, while anger and disgust were the most evident emotions when failure was induced by low effort in spite of high ability. Brophy (1981) showed that teachers were likely to deal with pupils' controllable problems with punishment and threatening actions, while they were likely to offer support for pupils' uncontrollable problems. Similarly, peer helping was more likely to occur when the learner needed help due to uncontrollable and stable reasons such as lack of ability rather than lack of effort (Barnes et al., 1979; Bennett, et al., 1998; Weiner, 1980).

There is a high possibility that teachers and pupils will have different attributions of an event, because of the tendency to make biased attributions (Fiske et al.1991; Nisbett et al. 1980). Pintrich (1996) explains these biased attributions. The fundamental attribution error involves the attribution of other's behaviour to a disposition or personal factors, ignoring situational factors that might be partially or even more causally related to the outcome. The *Actor-observer perspective* refers to attribution errors induced by attributing one's own behaviour to situational features, whereas observers will attribute actors' behaviour to some personal or dispositional characteristic of the actor.

Jones et al. (1972) explained that the existence or absence of distinctiveness information for actors and observers, would induce the anticipated actor-situation and observer-person inferential biases. Fiske et al. (1991) suggested that actor-observer differences occurred because actors base their inferences on environments, and observers base their inferences on the person because s/he is prominent. This disparate information leads the two parties to incongruous judgements.

Some earlier research studied the effects of controllable and uncontrollable factors of attribution on their affects towards learning, outcome expectancy for future learning and consequent behaviour outcomes of learning among Japanese students. Nasu (1990) suggested that attribution of failure in mathematics term examinations to lack of daily effort was positively related to feelings of regret, which led to positive learning behaviour and improvement of results in next term's examination. In contrast, attribution of failure to lack of ability was positively related to perceptions of incompetence, which led to negative learning behaviour and decreased performance. Achievement-related affect arising from attributional styles was related to learning behaviour and improvement of performance, but attribution styles themselves and the results of previous examination were not directly related to learning behaviour or improvement of performance.

Higuchi et al. (1986) showed that Japanese 4th–6th graders categorised as helpless tended to avoid attributing their success to ability, effort and task easiness, while they attributed their failure to lack of luck and lack of ability rather than lack of effort. Those categorised as self-displaying attributed failure to lack of luck or poor health. These children could not set up an appropriate level of goal attainment and perceived their level of success as low, although they had similar actual task achievement as pupils who had other attributional styles. Koizumi (1991) showed that Japanese 5th graders with higher academic self-concept attributed their success to ability, while those with lower academic self-concept attributed their success to task easiness or luck and their failure to lack of ability. The effect of effort-based attribution on mathematics self-concept was not clear in the case of either success or failure in Koizumi's (1991) study, probably because of the higher percentage of effort-based attribution than other attributional styles in both success and failure. Children making effort-based attributions were likely to do so for both success and failure, while ability-based attributions of success and failure were separate constructs. Taketsuna et al. (1990) reported that Japanese 7th graders attributing failure to task difficulty had low outcome expectancy for their next examination.

However, Covington's (1979) self-worth theory proposed that learners would attribute their failure to lack of effort in order to maintain a self-concept of high ability. Some studies with Japanese children reported such an effect of effort-based attribution in failure. For instance, Sakurai (1989) showed that Japanese 6th graders with higher levels of hopelessness were less likely to attribute their success to ability and were more likely to attribute their failure to effort. It was suggested that attributing failure to effort prevented children from experiencing the depression that might occur from attributing failure to ability, although children with higher levels of hopelessness might believe that effort did not lead to good results. Sugiura (1996) showed that the attribution of failure to lack of effort was positively related to outcome expectancy for Japanese 5th-6th graders with a low level of helplessness, but not for those with a high level of helplessness who did not understand the meaning of making effort.

Some studies have suggested that luck is perceived as an internal factor in some Japanese cultural contexts. This is different from Weiner's (1986) perspective, which defined luck (chance) as an external factor influenced by the environment rather than an individual trait. Kashiwagi (1986) proposed that luck would be more internalised as a personal trait for Japanese participants, and that their view of their own effort and luck together would be influential. She found that Japanese students attributed learning outcomes to both effort and luck. Little et al. (1997) found that Tokyo elementary school children responded that they did not know the reasons for success or failure in school performance. They postulated that this might occur because Tokyo children viewed unknown factors as fatelike and not because classroom practices lacked feedback information.

Some Japanese young children try to keep high self-esteem by ascribing their failure to external causes. For instance, Masuda (1994) showed that Japanese lower achievers in 11th grade who ascribed external and unstable causes also maintained high self-esteem, while high achievers ascribing internal and stable causes had high self-esteem. However, some research suggested that Japanese participants are not accustomed to have self-saving system. Hazel (1991) described, as found in Japanese culture, the other-saving bias or modesty bias whereby individuals attribute success to others and failure to self. This bias is contrary to the self-serving bias explained above. Little et al. (1997) found that Tokyo children were less likely to attribute their school performance to teachers' behaviours. Shikauchi (1978, 1983, 1984) showed that Japanese participants attributed their success to external factors such as task easiness and effective teaching more than to other factors, while they attributed their failure to lack of effort. Harnisch et al. (1983) found that Japanese students overall attributed their success to luck or task easiness, and their failure to lack of ability. These findings suggest that Japanese students' attribution style might cause their low self-esteem.

The other-saving or modesty bias can also be found in teachers' attributions of their teaching outcomes, and mothers' attributions of their success or failure in raising their child. They tended to attribute negative outcomes to their own lack of effort, rather than the children's. Lee et al. (1998) reported that Japanese teachers, overall, expressed less confidence in their teaching methods than American teachers. More than half of the Japanese teachers stated that they wanted to learn more about effective teaching, and 94% of Japanese teachers considered that improved teaching methods could improve pupils' mathematics performance. Bornstein et al. (1998) reported that Japanese mothers reported less competence and satisfaction despite the fact that they reported more willingness to invest time and energy in their children than mothers in other countries such as America. They attributed their success in child raising to their child's behaviour and task easiness due to the child's behaviour, while they attributed their failure in child raising to a lack of effort rather than blaming the child.

Kashiwagi (1986) compared developmental tendencies reported in USA and Japanese research regarding individuals' attributional style. Overall, USA participants increased internality attributions with increasing age, and this internality was reported to relate to achievement and self-esteem. Japanese participants' attribution became more complicated, and situation-specific external factors became more influential, while internality was related to rigour in self-evaluation.

An individual's attribution style has been reported to affect other aspects of affect as well. Hosaka (1989), in Japan, reported that confidence in doing mathematics and liking to do mathematics were separate factors. Ascribing success to ability positively affected confidence and liking. Ascribing failure to task difficulty negatively affected confidence, while ascribing failure to lack of effort reduced liking. Ito (1996) found among the Japanese 7th graders that provision of the informational feedback and teaching them how to learn the subject such as reviewing, summarising and constructing is reported as important for linking children's attribution of their failure to lack of effort to hope for future success.

Overall, these research findings indicate that attribution styles are different in relation to age and culture. Ascribing failure to lack of ability is related to lower outcome expectancy, lower academic self-concept, lower self-esteem and deteriorated motivation, and sense of shame. The negative effects of attributing failure to lack of ability may become stronger for older children, whose attribution style becomes more internal and self-evaluative. Ascribing failure to effort may give more positive effects than ascribing failure to ability, but it may not produce positive outcome expectancy for some Japanese, who adopt effort-based attribution as a measure to maintain their self-esteem. The Japanese tend to think that luck is a personal trait, which can co-exist with effort. Although the Japanese are likely to ascribe failure to the lack of their own effort rather than others', ascribing failure to lack of others' effort has been reported to produce anger and withdrawal of help. There is evidence that attribution styles can be changed.

Goal orientation and pupils' attitudes towards learning

The main focus of research relating to goal orientation theories is on the comparison of the two opposing concepts of goal orientation, mastery and performance, in terms of 'the way of approaching, engaging in, and responding to achievement situations' (Ames, 1992), although the exact labelling of these concepts varies according to each theory. Pintrich et al. (1996) have synthesised the comparisons made between *Mastery* and *Performance goals*. Pupils with mastery goals focus on how learning advances according to self-set standards, present adaptive attributions, and show positive cognition, affect, and behaviour. On the other hand, pupils with performance goals focus on performance outcomes, and attempt to avoid showing lack of ability or worth through relative assessment, in turn, present maladaptive attributional patterns, show negative influence on cognition and behaviour and build negative affect into failure.

Dweck et al. (Dweck et al., 1983; Dweck et al., 1988) argue that students' beliefs or perceptions of intelligence influence their goal orientation. Students with an entity theory, whereby intelligence is seen as fixed, are likely to adopt performance goals. These students tend to show mastery-oriented behaviour patterns, such as seeking challenge, and to have high persistence when they have high confidence in their intelligence, but show helpless behaviour, such as avoiding challenge or low persistence, when their confidence in their intelligence is low. Students with an incremental theory, whereby intelligence is viewed as malleable, are likely to focus on mastery goals and mastery-oriented behaviour, irrespective of whether their confidence in their intelligence is high or low (Dweck et al., 1988).

Research with Western participants has shown that attributional processes are regarded as changing according to developmental stage. Young children tend to see ability as more incremental and changeable (Dweck et al., 1983; Dweck et al. 1988). Older children have trait-like perceptions of the nature of intelligence. At about 12 or 13 years, children begin to differentiate between effort and ability (Nicholls, 1990) and believe that effort cannot make a difference in tasks depending on luck (Nicholls et al., 1983, 1985). Individuals' perceptions of intelligence, applying entity and incremental theories are perceived as part of a continuum rather than being dichotomous, and the applicability of the two theories may vary according to the task (Pintrich, 1996).

Research on goal orientation has shown that students' goal orientation is very amenable to change, depending on environmental cues and presses. For instance, Ames's (1992) synthesis of work on students' goal orientation indicates that reduction in the public nature of comparison with others, and the introduction of assessment focused on individuals' improvement and mastery helps students adopt a mastery goal. This finding is particularly applicable to the children after about age 7, because children become objective and normative about their ability around this age (Nicholls et al., 1983, 1985).

Traditionally, Japanese culture supports the incremental idea of intelligence. This conception of intelligence is believed to derive from the Chinese Confucian Mencius (372-289 B.C.) by whom human nature was perceived as fundamentally good. Kojima (1986) described Kihara's (1710) theory regarding the Japanese culture of child raising, whereby all children are perceived to be born with equal virtues and intellectual abilities and differences between children arise from environmental factors, especially the extent to which adults support children's autonomous development. Peak (1991) describes how Japanese teachers praise children as jozu (skillful) not only in relation to achievement but also in relation to attitudes such as concentration. This praise informs children that positive attitudes are developed through practice, rather than as a function of personality or the child's tendencies.

Some research has reported on Japanese students' incremental idea of intelligence. The TIMSS results in 1994 showed that the percentage of 4th and 8th graders who agreed that some children have innate mathematical ability in Japan was lower than in other countries. Stevenson et al. (1992) reported that Japanese 5th graders disagreed strongly with the idea that test results showed the natural ability of the performer, and Japanese mothers were reported to make effort-based attributions of their children's school performance. Kimura (1989) reported that Japanese 5th graders believed that everyone had the same level of mathematics ability, although some research reported that Japanese children's mathematics performance was positively related to their intelligence test scores (e.g. Uttal, 1988).

Holding an incremental idea of intelligence affects attributional styles, belief systems and behaviour outcomes. First, it leads to effort-based attributional styles, as explained in the previous section. Secondly, it values perseverance for achieving goals. Blinco's (1991) study showed that Japanese 1st graders, especially children who received home/family encouragement and support, persisted more in difficult tasks than American counterparts. Stevenson et al. (1992) showed that Japanese 5th graders showed greater persistence when faced with a difficult problem than their American counterparts and were more likely to prefer solving fewer problems with higher accuracy. However, children's perseverance on a task may not produce confidence, satisfaction and positive outcome expectancy for future tasks (Stevenson et al., 1992). Horikawa (1991) reported that Japanese mothers tended to set higher standards and required higher achievement for their satisfaction than American mothers. This tendency became stronger as children proceeded through the grades. Japanese 5th graders believed less that their teaches and parents were happy with their mathematics performance than American 5th graders.

The incremental idea of intelligence also leads to valuing informational feedback, because the Japanese believe that all children can learn equally if enough informational feedback is provided. Uttal (1988) reported that Japanese mothers were reported to attribute their child's problems in mathematics learning to a lack of specific skills or knowledge of mathematics, while American mothers holding an entity idea of intelligence attributed problems to the child's low intelligence or inability to pay attention. Provision of informational feedback is believed to link to children's positive affective attitudes, as discussed in the early section of this chapter.

To summarise, age and cultural differences seem to exist in pupils' goal orientations. Western theories propose that pupils' goal orientation moves from an incremental theory of intelligence to an entity theory after around age of 12. As a result, pupils come to focus on performance outcomes rather than on the learning process according to self-set standards, and present maladaptive attributions which show negative influences on cognition, affect and behaviour. Environmental factors such as criterion-based assessment have been reported to support pupils in maintaining a mastery goal. Japanese culture supports the incremental theory of intelligence, which leads to Japanese pupils' holding effort-based attribution styles and persevering to achieve goals, and to informational feedback being provided in teaching. However, research shows that Japanese pupils' incremental idea of intelligence does not necessarily produce confidence, satisfaction or expectancy of successful outcomes in learning.

2.5: Conclusions

How does the literature described above relate to the four questions set out at the beginning of this chapter? The first question was what factors are assumed to influence pupils' affective attitudes towards learning. The literature suggests that pupils' perceptions of their competence and their internal perceptions of control (autonomy) determine their enjoyment in learning, i.e. intrinsic motivation. These factors also influence pupils' sense of security and progress. Although individuals are assumed to perceive, interpret and make attributions about the social environment, the effects of environmental factors on pupils' perceptions of their competence and autonomy seem substantial. It follows therefore that teachers can help pupils to form positive affective attitudes towards learning.

The second question is whether pupils' enjoyment, motivation, sense of security and sense of progress are related to each other. Overall, these aspects of pupils' affective attitudes have been reported as being related. The literature suggests that intrinsic motivation can co-exist with internalised motivation, which is initially promoted by external rewards through socialising agents, but is then maintained spontaneously through self-reward. Intrinsic motivation and internalised motivation together enhance pupils' affective attitudes towards learning, promote pupils' perception of their competence and reduce anxiety, and in turn, lead to better performance. Developing pupils' perception of their competence in learning and ensuring their autonomy in learning are important to promote intrinsic and internalised motivation. However, extrinsic motivation, another construct of motivational orientation, relates negatively to intrinsic motivation, sense of security and sense of progress. Pupils' perceptions of themselves as being competent have been reported as reducing their anxiety in learning and producing positive motivational behaviours, while perceptions of low competence can lead to worry about performance, and anticipation of the possible consequences of failure. Where this is the case pupils depend much more on extrinsic motivation. Pupils' intrinsic motivation, internalised motivation, sense of security and sense of progress appear to be mutually related.

The third question is whether a difference in pupils' attitudes towards learning in mathematics exists between students in the late stage of elementary school and in junior high school. The American literature reports that pupils' intrinsic motivation, interest, appreciation of learning, competence beliefs, confidence, and self-esteem decrease dramatically, and their anxiety increases, at transition from elementary school to junior high school. The literature explains that the deterioration in older children's motivational consequences is partly due to developmental change, such as greater competence in acquiring social comparisons and the change to entity-like perceptions of intelligence. Children's uncertainty regarding whether they can control learning through their competence after transition produces uncertainty of judgement about their own cognitive competence; such uncertainty may lead to a decrease in their intrinsic motivation. However, environmental factors, such as a more competitive, evaluative, controlling and impersonal school and classroom atmosphere in junior high schools, will also have negative effects on pupils' affective attitudes towards learning. Children with low perceptions of their own competence are especially vulnerable to environmental effects.

Taken together, the findings from the literature indicate that pupils' enjoyment, motivation, sense of security and sense of progress are related to each other. Pupils' perception of their competence and autonomy in learning are assumed to be main factors in maintaining favourable affective attitudes. Although individual differences seem to exist in ways of reacting to environmental stimuli, teachers can support pupils by intentionally developing their perceptions of their competence and their autonomy in learning. The possible measures identified which teachers can take in a classroom include:

- Encouraging pupils to believe that they can manage the task;
- The introduction of criterion-referenced evaluation and avoiding too strict norm-referenced evaluation;
- The provision of competence feedback rather than controlling feedback;
- Supporting pupils in setting up optimal and specific self-determined learning goals;
- The provision of tasks with optimal level of difficulty;
- Preparing learning activities and materials containing challenge, curiosity and fantasy;
- Informing pupils of the meaning and purposes of learning;
- Promoting positive relationships in a class, to support the individual child's performance outcomes.

In the new Course of Study, the Ministry of Education in Japan proposes these measures to promote pupils' affective attitudes towards mathematics learning.

The fourth question concerns whether pupils' perceptions of self, classroom ethos and motivational orientation affect their enjoyment, motivation, sense of security and sense of progress. The literature suggests that these aspects of pupils' perceptions are related to their attitudes towards mathematics learning. Western theories propose that outcomes being compatible with the ideal self, satisfaction in classes, effort-based attribution, and mastery goal orientation based on an incremental theory of intelligence produce positive effects on pupils' affective attitudes. In contrast, incompatibility between ideal and actual self, perceived difficulty and friction and high competitiveness in classes, ascribing failure to lack of ability, and performance goal orientation based on the entity theory of intelligence produces negative effects on pupils' affective attitudes; these are found in older children. Teachers can support pupils in having positive affective attitudes towards learning. For instance, criterion-based assessment emphasising individual improvement and effort has been reported to promote pupils' positive affective attitudes towards learning.

There appear to be cultural differences in pupils' perceptions of self, classroom ethos and their motivational orientation. Japanese children develop a self in relation to others, prefer co-operation to competition, make effort-based attributions of both success and failure, and have an incremental theory of intelligence. These features of Japanese pupils' perceptions have been reported to produce positive affective attitudes towards learning. However, some research suggests that too much emphasis on effort in learning may produce negative effects such as lack of confidence, satisfaction, liking towards learning and outcome expectancy. When teachers ascribe pupils' negative performance outcomes to lack of pupil effort, teachers may withdraw from giving sufficient support to these pupils. These are features found in Japanese schools. The Ministry of Education in Japan is currently concerned about them.

To further our understanding of these issues in terms of the teaching methods adopted in mathematics classes, this project aims to research the following three key questions.

Question 1: Do teachers and pupils belonging to 5th and 8th grades perceive that pupils' enjoyment, motivation, feelings of security and sense of progress are affected in a similar way by different teaching methods deployed in mathematics classes?

- Do teachers and pupils perceive that pupils' attitudes towards learning mathematics are influenced by the various teaching methods adopted in mathematics classes in a similar way?
- Are some teaching methods and not others perceived to promote particular affective attitudes?
- What are the perceived relationships between affective attitudes and teaching methods?

Question 2: What contributes to pupils' enjoyment, motivation, sense of security and sense of progress in mathematics classes?

Question 3: Do teachers and pupils perceive that pupils' attitudes to learning mathematics are affected by pupils' perceptions of self, their motivational orientation or classroom ethos? Are there any differences in perceptions between groups?

In relation to pupils' self-perceptions and motivation, the following will be considered.

- General self-concept and competence beliefs about mathematics
- Classroom ethos
- Attribution of perceived mathematics performance
- Goal-setting orientation

The following chapter will consider the research methods appropriate for answering these questions.

CHAPTER 3: METHODOLOGY

3.1: How was the research conducted?

This study adopted a cross-sectional survey strategy, using questionnaire and interview methods. The survey strategy is effective for gathering data drawn from large samples and generalising to the whole population. It is within that framework of research defined by Kerlinger (1964) as the relative incidence, distribution and interrelationships of naturally occurring phenomena. Robson (1993) indicates that there are three main research strategies: experiment, survey and case study. This study adopted survey strategies. These characteristics of surveys match well with the aims of the study, which aims to examine the perceptions of teachers and pupils of 5^{th} and 8^{th} grades and obtain generalisable findings.

An alternative approach would have been to adopt a case study strategy which develops detailed and intensive knowledge about a single case or a small number of related cases. Schools or teachers adopting a new teaching method sometimes publish their own report as a case study based on their experience. Such studies contribute to finding out what is going on, and may provide other new insights, but cannot lead to a generalised finding. The intention of this study was to obtain findings, which might be generalised to some extent even if the depth of information obtained was limited. An experimental strategy measures the effects of manipulating one variable on another variable. Comparisons of the effects of deliberately assigned teaching methods have often been conducted as experimental research, although most of these studies focus on the effects of the teaching methods on the pupils' attainment, as mentioned in the first chapter. This study aims to investigate teachers' and pupils' perceptions of pupils' attitudes towards learning reflected in their perceptions of teaching methods adopted in natural settings: no control conditions were included.

Information in this study was sought from a consideration of data derived from pupils and their teachers at different ages at one time, relating to the introduction of educational reform 2002 in Japan. This aim is well matched with the distinctive features of cross-sectional studies, which focus on the make-up of the different groups of the sample, and the state of affairs in the population at one point in time. This differs from longitudinal research, which examines the same set of people, and/or the same issue or situation over a period of time (Robson, 1993).

As Robson (1993) points out there are three main purposes of enquiry: exploratory, descriptive and explanatory. This study mainly adopts an exploratory purpose, because such research has not been undertaken previously in Japan. Findings in this study may enable a more accurate description of students perceptions of specific contexts, and their effects, which may also enable integration of previous research. This study will not deepen existing knowledge, but rather explore whether and why there are differences in the perceptions of pupils' attitudes towards learning mathematics between 5th and 8th graders and their teachers and how these relate to different teaching methods. The explanatory purpose, as Robson (1993) defines it, is less important in this study.

Research tactics are the methods or techniques used to collect information. Robson (1993) points out that there are three main research tactics for enquiring about 'the real world': observation, interview and questionnaire. This survey, first, adopted a questionnaire method with both teachers and pupils. Afterwards, an interview method was employed with approximately one-third of the teachers who completed the questionnaires. The interview method was not employed for pupils, chiefly because of the difficulties of obtaining school and parental permission for such individual contact with children. The chief reason for using the questionnaire method in this study lies in its suitability for collecting a wide range of information from a large number of participants in a limited time. The larger sample size also improves the possibility of generalising the findings (Oppenheim, 1996).

The information obtained through a questionnaire survey, however, may lack reliability and validity. A questionnaire method may secure only limited compatibility between participants' responses on the questionnaire and their acts in 'real life' (Oskamp, 1977; Hanson, 1980). In order to obtain a meaningful result through a questionnaire survey, the questionnaire needs to be well constructed, instructions need to be very clear and unambiguous, and questions require careful wording. Interpretation may pose another limitation on validity and reliability (Robson, 1993). However, these concerns are also shared in relation to the interview method, which obtains information through interpersonal communication. Overall, the observation method is the one most likely to provide the researcher with information which reflects ‘real life’, with its directness and lack of artificiality (Robson, 1993). Observation has, often, been employed as a research method, to assess the environment. For instance, Murray (1938) introduced the terms “alpha press” to describe the environment as assessed by a detached observer and “beta press” to describe the perceived environment of a milieu’s inhabitants. In the current study, initial attempts were made to find opportunities for observation. However, a very limited number of schools showed interest in taking part in observation, on the grounds of the difficulties of securing teachers’ co-operation and parental permission.

The possible limitations of the absence of observation need to be examined. Fraser et al. (1981, 1986) note that obtaining a high level of inference, when the respondent makes a judgement about the meaning of classroom events through using questionnaires is related more to psychological significance than obtaining a low inference, which concerns specific explicit phenomena studied through the observation method. Information on pupils’ perceptions over many lessons obtained through a questionnaire method is more likely to reflect the situation accurately than information based on observational data restricted to a very small number of lessons. Information on pupils’ perceptions from questionnaires involves the pooled judgements of the pupils’ learning in a classroom, whereas information based on observation involves only one single observer. Pupils’ perceptions, which in part may be assumed to determine their behavior, may be more important than observed behaviors. Perceptual measures of the classroom environment are likely to account for considerably more variance in student learning outcomes than directly observed variables.

Eccles et al. (1993b) acknowledged that independent observer’s ratings are beneficial for comparing the perceptions of different groups because elementary and junior high school teachers might interpret similar features of classrooms differently. Changes in students’ development, psychologically and socially, rather than changes in the classroom environment may affect their perceptions. However, Eccles et al. (1993b) commented that comparable results using teachers’ and students’ reports actually provided more useful and significantly meaningful information than information gained through observation. In addition, observation does not guarantee strong reliability and validity, any more than other research techniques. Observation may also cause some bias in the process of collecting data and analysis. For instance, the behaviours of the observed persons may be affected by their awareness of being observed. The observers' attention, encoding, interpretation and memory may be subjective or selective. Consistency of the analysis of the same behavior may not be maintained in the results produced by an observer across time or in the results produced by several observers. Thus, some uncertainty regarding validity and reliability remains, irrespective of the methods selected (Robson, 1993). In the light of this, the questionnaire method was selected, which was beneficial for achieving the research aims, while attempting to minimize biases during the design, execution, analysis and reporting of the findings.

Superficiality is another possible weakness, in adopting a questionnaire method. In this study, this weakness was addressed through the adoption of the interview method as a follow-up. Interviews can provide great richness of data and spontaneity in responses by using effective probes (Oppenheim, 1996). Interviews also offer the possibility of modifying the line of enquiry, and can help in understanding verbal responses from non-verbal cues (Robson, 1993). The interviews provided triangulation through employing different methods with the same aim (Denzin, 1970, in detail Cohen, 2000). This also aims to increase concurrent validity (Campbell et al., 1959), overcome the problem of 'method-boundedness' (Boring, 1953), deepen understanding of the information obtained in the questionnaire survey and validate information obtained from questionnaires. As mentioned above, interviews with pupils were not used because of the difficulties in obtaining permission from schools and parents. However, deeper insights into pupils' perceptions were obtained by employing open questions in the questionnaires.

To conclude, the perceptions of the teachers of two age groups, the pupils of the two age groups and those of the teachers and pupils of each individual group were collected through a questionnaire survey. As comparisons were to be made between groups, the questionnaires were designed to be compatible as far as possible between the pupils of the two age groups, although they were not identical. The questionnaires for the teachers of the two groups were identical. The questionnaires for teachers and pupils were constructed so that a meaningful comparison could be conducted between their responses.

3.2: The design of the questionnaire for pupils

Four pilot studies were conducted in constructing the questionnaire for pupils before the main survey. This repeated conduct of pilot studies aimed to tighten the scope of the questions, clarify the accessibility of the words used for the pupils, and ensure completion in the time allocated. The first pilot study for the pupils' questionnaire was conducted with five 5th graders because employing the same questionnaire for both 5th and 8th graders might have posed difficulties for the 5th graders, in relation to access to words and in assessing their views. Therefore, the first pilot study focused on accessibility for 5th graders. Originally, open-ended questions, asking why particular teaching methods gave them more positive attitudes towards learning mathematics than other methods, were included. However, most of the 5th graders taking part in the first pilot study found difficulty in expressing their opinions in their own words. As a result, the open-ended questions were eliminated from the questionnaire for 5th graders.

The second pilot study was conducted with sixteen 5th graders and eighteen 8th graders. In addition to completing the questionnaire, the participants were required to report how long completion took. This varied, from five minutes to thirty minutes. The instructions and questions seemed to be clearly understood by pupils from both grades. The majority of the 8th grade participants were able to express in sentences their views on why their attitudes towards learning mathematics were promoted by particular teaching methods in mathematics classes.

The third pilot study was conducted, with thirty-six 5th graders in a mathematics classroom at an elementary school in Tokyo, in order to see to what extent the revision of the questionnaire had improved its accessibility for the pupils. A group-administered questionnaire method was used with their teacher reading aloud. This can be beneficial for children, especially those who experience difficulties in reading questions, because it can ensure that all the respondents proceed in the same order and do the same thing at the same time (Oppenheim, 1996). However, quick respondents have to wait for others to finish. Therefore, this method may take longer than a self-administered questionnaire. After the observation of the pupils' completion of the questionnaire, the teacher taking part in the pilot study was asked to feed back to the researcher. According to her comments, the questions seemed to be clear to the pupils, and the work was completed within one lesson of 45 minutes.

The fourth pilot study was with one class of 5th graders and one class of 8th graders. A group-administered questionnaire, read aloud by the teacher, was employed for the 5th graders; a self-administered questionnaire under the teacher's supervision was employed for the 8th graders. The self-administered questionnaire method was adopted for 8th graders because it minimises the contamination, which may occur through talking or asking questions when someone is reading aloud (Oppenheim, 1996). Both teachers supervising their pupils' completion of the questionnaire were asked for their comments on the procedure. Based on their recommendations, some alternations mentioned in each section below were made. These informed the final version of the questionnaire.

The questionnaire for pupils was constructed to obtain information in five domains. The first domain concerned pupils' reports on the frequency of the deployment of different teaching methods and their perceptions of their attitudes towards learning mathematics in terms of the teaching methods used in mathematics classes. The second concerned pupils' perceptions of their self-concept and mathematics concept. The third concerned pupils' attributions of their perceived outcomes in learning mathematics. The fourth concerned their perceptions of teachers' praise in mathematics classes. The fifth concerned pupils' perceptions of classroom ethos.

Pupils' perceptions of teaching methods in mathematics classes

The Ministry of Education in Japan (1999) recommended the introduction of activity-based learning, an effective choice of organisational strategy, provision of opportunities for peer-interaction and the practical use of computers in addition to those teaching methods traditionally adopted by teachers in Japan for educational reform 2002. The teaching methods considered in this study were selected in relation to those recommendations. This selection of teaching methods was also examined through the pilot study with the teachers; this is described in the section on the pilot study for the teachers' questionnaire. As a result, eight teaching methods were included: practical work, using computers, reading textbooks, teachers' explanation, individual work, individual help, whole-class discussion and group discussion. The second issue to be considered was the extent to which pupils were familiar with the words describing these teaching methods. Since this survey was conducted before the introduction of the reforms, not all the teachers in mathematics classes were expected to be using all these teaching methods. Pupils might therefore be unfamiliar with the words used to describe the teaching methods in the questionnaire. To solve this possible problem, examples of earlier survey research regarding teaching methods with children in the upper stage of elementary school were examined. In Japan, the National Institute for Educational Research (1990), which investigated 4th graders' preferences for 'whole-class learning sessions' or 'individual learning sessions' in mathematics classes, used these words, with explanations of what each kind of learning session was. In England, Hall (1995) who investigated 7 to 11 year-old children's perceptions of teaching methods, used concrete words suggesting the teaching methods, with explanations about each method. Following these examples, this study used explanatory sentences for the first appearance of the description, in order to promote pupils' understanding of what each teaching method involved. From the second appearance, these words were arranged in the corresponding order, to save the time and effort needed to read a long explanation each time, and also space on the questionnaire sheet. Confusion due to not understanding the words describing teaching methods was not found in the pilot study. Therefore, these descriptions were used in the main survey. The teaching methods included in the study are presented in Table 3.2.1 below.

Table 3.2.1: Teaching methods included in this study

Descriptions	Explanation corresponding to the concrete words
Practical work	Doing practical work in a small group, for example, making something together, doing experiments or investigation.
Using a computer	Using a computer.
Reading a textbook	Reading about something, for instance, explanations in textbooks.
Teacher explanation	Listening to the teacher explaining to the class, and the teacher asking the class questions.
Individual work	Doing individual work such as doing exercises.
Individual help	Individual help: talking to the teacher on your own about your work.
Whole-class discussion	Whole-class discussion where you give your ideas and you listen to others giving theirs.
Group discussion	Small-group discussion where you give your ideas and you listen to others giving theirs.

The study also examined pupils' reported frequency of experiencing different teaching methods and their affective attitudes towards learning mathematics in relation to their enjoyment, motivation, sense of security and sense of progress. These features of pupils' attitudes towards learning were, as mentioned in chapter one, aspects that Japanese children currently are perceived to lack. The words employed to communicate these features on the questionnaire were chosen after discussion with many elementary and junior high school teachers during the pilot studies. The accessibility of the language was also checked in the pilot studies with the pupils.

The word 'enjoyment' is often used in Japan with reference to learning settings. For example, the National Institute for Educational Research's (1990) questionnaire survey of 4th graders in mathematics classes, mentioned above, started with the question, 'Did you enjoy learning the topic 'area' in the individual session?' The word 'motivation' is a technical term in psychology. The NIER's (1990) study mentioned above used the words 'try hard to learn' when enquiring about children's motivation. The Japanese expression *'Ganbaru'* (trying hard), was introduced into the international literature as the word expressing the Japanese educational ethos (e.g. Stevenson, 1992). The word translated here as 'sense of security' was taken from the sentence 'schools should be places where children feel relaxed and comfortable about concentrating on learning' in the recommendations of the Curriculum Council (1998). This study adopted this explanation to express 'sense of security'. Attempts were made to select words, which communicated to the pupils that 'having a sense of progress' is a term focusing on their feelings about progress rather than actual progress. Repeated discussion with teachers and the results of the pilot studies confirmed the high probability of success in communicating the researcher's intentions to the pupil participants. The questions employed in the questionnaire for pupil participants were as follows.

- How often do you have these kinds of learning methods in your mathematics lessons?
- Do these methods help you to enjoy learning mathematics?
- Do these methods encourage you to try hard in mathematics?
- Do you feel relaxed in learning mathematics by using these particular methods?
- Do you think these methods help you to feel that you are making progress in learning mathematics?

Pupils' perceptions of the frequency of use of different teaching methods and of attitudes towards learning mathematics in terms of the teaching methods in mathematics classes were measured adopting closed questions with a five-point rating system. The question measuring the pupils' perceptions of the frequency of the use of teaching methods adopted five ratings: *always, nearly always, sometimes, hardly every* and *never.* The question measuring the pupils' attitudes towards learning mathematics in terms of teaching methods adopted five ratings: *absolute agreement, agreement*, *neither agreement nor disagreement*, *disagreement* and *absolute disagreement.* One difficulty with rating scales is that individual participants may interpret differently what each rating indicates, so objectivity may not be secure (Oppenheim, 1996). However, ratings are, in this case, used in a subjective way to indicate raters' perceptions (Oppenheim, 1996) of the frequency of the use of teaching methods and pupils' attitudes towards learning mathematics promoted by different teaching methods. Some researchers prefer to use an even number of steps, to avoid the tendency to choose the central option (Oppenheim, 1996). However, in the pilot study, some 5^{th} graders found difficulty in responding to a scale with four steps, which lacked the central option. Therefore, a five-point scale was adopted.

8^{th} graders were also required to express their opinions, in their own words, as to why they thought particular aspects of their attitudes towards learning mathematics were promoted by a particular teaching method. Closed questions whereby the respondents are offered a choice of alternative replies have the advantage that the respondents require little time to complete them and that group comparison is easy. However, open questions provide respondents with the freedom to reply in their own language and express themselves spontaneously (Oppenheim, 1996). Open questions were not employed in the questionnaire sheet for 5^{th} graders, because of their difficulties in expressing their opinions in this way, as mentioned above in the section on the pilot study. The questions, which asked 8^{th} graders why they thought that particular aspects of their attitudes towards learning mathematics were promoted by the particular teaching methods, were as follows.

- Why do you think that particular teaching methods allow you to enjoy learning mathematics?
- Why do you think particular teaching methods encourage you to try hard in mathematics?

- Why do you think particular teaching methods let you feel relaxed in learning mathematics?
- Why do you think these teaching methods help you to feel that you are making progress in learning mathematics?

Pupils' self-concept and mathematics concept

Pupils' mathematics self-concept was measured through the Mathematics Scale in Marsh's SDQ I (1990a) for 5th graders and his SDQ II (1990b) for 8th graders, respectively. The literature indicates that the pupils' self-concept and academic concept are correlated (Harter, 1985a, 1986; Marsh, et al., 1984; Marsh, et al., 1985). Therefore, the pupils' self-concept was also measured through the General-Self Scale of Marsh's SDQ I (1990a) for 5th graders and SDQ II (1990b) for 8th graders, respectively.

Marsh' SDQ I (1990a) consists of eight scales, while Marsh's SDQ II (1990b) consists of eleven scales. These scales were devised according to the theory of 'a multifaceted, hierarchical model' of self-concept proposed by Shavelson et al. (1976). In Shavelson et al.'s (1976) model, the mathematics concept consists of an academic concept followed by the general self-concept at the apex. The General-Self Scale measures the child's self-worth, self-confidence and self-satisfaction, while the Mathematics Scale measures pupils' self-concept regarding their ability, enjoyment, and interest in mathematics (Marsh, 1988, 1990a,1990b).

Chapter two also reviewed the literature regarding the Perceived Competence Scale for Children (the PCS) established by Harter (1981). The PCS contains a General self-worth Scale, which measures the pupils' self-esteem or self-worth. The PCS measures children's competence in an academic domain on a cognitive competence scale, but it does not adopt subject specific scales. Marsh's (1986b, 1990a, 1990b) study suggested that verbal and mathematics self-concepts were almost uncorrelated with each other and had quite distinct relations to verbal and mathematics achievement scores. Therefore, this study, which focuses on children's perceptions of mathematics, preferred the SDQ-I and SDQ-II to the PCS. Another reason for not adopting the PCS was the complexity of the scales. On the PCS, each item consists of two logically opposed statements. The child first decides which statement reflects the self more appropriately, and then decides to what extent that statement reflects the self. Marsh (1988, 1990a, 1990b) noted that this complicated response format not only posed difficulties for young children but also led to negative item effects, because of the low validity of responses to negatively worded items. SDQ-I and SDQ-II employ Likert scales. The Likert scales measure respondents' attitudes from the total scores for a series of items (Oppenhein, 1996). This item format was simpler than the PCS. The Likert scales provide more precise information about the respondents' degrees of agreement or disagreement than when simple agree/disagree responses are used. One disadvantage of measurement with the Likert scale is the lack of reproducibility, whereby the same total score may be obtained in many different ways (Oppenheim, 1996). However, this did not cause problems for this study, because the study required an ordering of the participants with regard to their self-assessment using self-concepts and mathematics concepts rather than distinct differences in their perceptions of individual items as in the Likert scales.

The advantage of making use of standardised assessment is that it can provide a high level of reliability and validity (Robson, 1993). For instance, SDQ-I and SDQ-II clearly support the multifaceted, hierarchical conceptualisation of the self-concept in Shavelson's (1976) model: other self-concept instruments fail to do so (Marsh, 1988, 1990a, 1990b). In this sense, the construct validity of SDQ-I and SDQ-II, in terms of within-network studies, is supported. The results of SDQ-I and SDQ-II support the construct validity of these tests in terms of between-network studies, in relation to the U-shape of self-concepts on age and academic achievement indicators. The internal consistency coefficient alpha has been reported as .89 for the Mathematics Scale and .81 for the General-Self Scale in SDQ-I, and as .90 and .88, respectively in SDQ-II. Stability over time has also been reported as generally high, although not as high as the internal consistency estimates. This is due to the systematic change in the students' self-concept over time (Marsh, 1988, 1990a, 1990b). Attempts were made to keep high reliability and validity in the standardised instructions in the process of translation. All instruments were translated into Japanese by the researcher. Afterwards, another Japanese researcher back translated them into English for verification of the translation. This process was repeated until compatibility was achieved in the back-translated English version. This process is popularly adopted in studies applying instruments devised in one language for use in another language to make them accessible to the participants and also to ensure reliability and validity (e.g. Ho, et al., 2000).

Three changes were made for the purpose of the study. Firstly, a five point rating system was adopted for 8th graders, although SDQ-II adopted a six-point rating system. This was because the pilot study showed that a five-point rating system, which contained a central option, was more acceptable for 8th graders. SDQ-I adopted a five-point rating system, and this rating system remained for 5th graders. Secondly, SDQ-I for 5th graders, originally, included some negatively worded items in order to avoid positive response biases, although the SDQ-I manual suggested that these negatively worded items were not included in the self-concept scores due to the low validity of responses, especially for low achievers (Marsh, 1986a). In the current study, these items were omitted altogether. The negative items in SDQ-II for 8th graders were retained. Thirdly, both SDQ-I and SDQ-II, originally, arranged the questions across a wide range of scales in a mixed manner. While this can be beneficial for reducing biases such as the halo-effect, whereby the respondents rate their general feelings on all the items rather than assessing the items separately (Oppenheim, 1996), many teachers reviewing the pupils' questionnaire survey in the pilot studies mentioned that pupils were confused as to whether questions in the General-Self Scale were limited to self-concepts in mathematics classes. Therefore, it was decided to arrange the items belonging to the General-Self Scale and the Mathematics Scale separately in the questionnaire design for both 5th and 8th graders. Table 3.2.2 below contains the questions of SDQ I adopted in the questionnaire for 5th graders in this study. Table 3.2.3 below contains the questions of SDQ II adopted in the questionnaire sheet for 8th graders in this study.

Table 3.2.2: General-Self Scale and Mathematics Scale of SDQ-I for 5th graders

General-self Scale	Mathematics Scale
I do lots of important things.	Work in mathematics is easy for me.
In general, I like being the way I am.	I look forward to mathematics.
Overall I have a lot to be proud of.	I get good marks in mathematics.
I can do things as well as most other people.	I am interested in mathematics.
Other people think I am a good person.	I learn things quickly in mathematics.
A lot of things about me are good.	I like mathematics.
I'm as good as most other people.	I am good at mathematics.
When I do something, I do it well.	I enjoy doing work in mathematics.

Table 3.2.3: General-Self Scale and Mathematics Scale of SDQ-II for 8th graders

General-Self Scale	Mathematics Scale
Overall, I have a lot to be proud of.	Mathematics is one of my best subjects.
Overall, I am no good.	I often need help in mathematics.
Most things I do, I do well.	I look forward to mathematics classes.
Nothing I do ever seems to turn out right.	I have trouble understanding anything with mathematics in it.
Overall, most things I do turn out well.	I enjoy studying for mathematics.
I don't have much to be proud of.	I do badly in tests of mathematics.
I can do things as well as most people.	I get good marks in mathematics.
I feel that my life is not very useful.	I never want to take another mathematics course.
If I really try I can do almost anything I want to do.	I have always done well in mathematics.
Overall, I'm a failure.	I hate mathematics.

This study attempted to assess pupils' perceived mathematics performance by asking them to what extent they perceived themselves as good or bad at mathematics, on a five point rating system: *very good, good, OK, poor*, and *very poor*. The question did not aim to assess the pupils' mathematics competence objectively. Rather, it aimed to obtain the pupils' subjective perceptions of their mathematics performance. Pupils' perceptions of their own competencies in mathematics are not necessarily reflected in their visible achievement such as marks obtained in the mathematics tests and it is the pupils' subjective perceptions of their mathematics performance that relate to their attitudes and affect, as has been discussed in previous chapters. This question seemed to overlap with the item 'I get good marks in mathematics' in the mathematics concept construct in SDQ-I and SDQ-II mentioned above. However, the employment of this question actually had two important roles in the construction of the questionnaire. One was to confirm whether pupils confused the direction of 5 and 1 indicated in the questions based on SDQ I and SDQ II. Some pupils taking part in the pilot study, although they replied that they perceived themselves as good at mathematics, chose a very low point on the Mathematics Concept Scale, due to their confusion about the direction which the level of the scores indicated. Including a question asking for a similar response was beneficial to confirm that individuals understood the direction of 5 and 1 indicated in the mathematics concept construct. The other role of this question was to act as a filter for the question asking about pupils' attribution of their success or failure in learning mathematics, as described in the next section.

Pupils' attribution of their perceived outcomes in learning mathematics

The pupils' attribution of their perceived outcomes in learning mathematics was measured using a nominal (categorical) response system. Nominal (categorical) data have neither numerical value nor an underlying continuum. The respondents are expected to choose their own response(s) from a number of discrete categories (Oppenheim, 1996). A single-choice question was employed. This aimed to obtain a clear response as to how they attributed their mathematics performance. An 'other (please specify)' category was adopted for 8th graders, in order to avoid loss of rapport due to their feeling that the choice of answers failed to do justice to their own ideas (Oppenheim, 1996). 5th grade teachers taking part in the pilot study commented that such an additional response might confuse 5th graders. Therefore, 'other (please specify)' category was not adopted in the questionnaire sheet for 5th graders.

A filter question, which excludes some respondents from a particular question sequence if those questions are irrelevant to them, was employed. The pupils who responded that they were very good, good or OK at mathematics were asked their views on why they thought they were successful in learning mathematics. On the other hand, pupils who responded that they were poor or very poor at mathematics were asked for their views on why they thought that they were failing to learn mathematics.

Table 3.2.4: Statements indicating pupils' attributions of their perceptions of their own competencies in mathematics

Assumed factor	Attributional category of pupils' success in learning mathematics	Attributional category of pupils' failure in learning mathematics
Ability	I am talented in learning mathematics.	I am not talented in learning mathematics.
Effort	I try hard to learn mathematics.	I do not try hard to learn mathematics.
Luck	It is just lucky if I do well at Maths classes.	It is just unlucky if I do not well at Maths classes.
Teacher instruction	The instruction of our Maths teacher is very good.	The instruction of our Maths teacher is not very good.
Familial support	I have enough support to do well from my parents or *juku* teachers.	I don't have enough support to do well from my parents or *juku* teachers.
Task difficulty	Tasks and tests are not so difficult in Maths classes.	Tasks and tests are very difficult in Maths classes.

The above table 3.2.4 shows the statements indicating the attributions in the questionnaire sheet. The categories reflecting the pupils' attributions employed in this study were ability, effort, luck, support from their mathematics teacher, support at home, and task difficulty. Weiner's (1986) achievement attributions, classified by locus, stability, and controllability dimensions, indicate that effort can be divided into two kinds, with long-term effort as a stable factor and temporary or situational effort for examinations as an unstable factor. Similarly, teachers' support can be divided into two kinds, with instructor bias/favouritism as a stable factor, and help from the teacher as an unstable factor. This study did not adopt this division. Weiner's (1986) model, mentioned above, includes health on the day of examination as an internal, unstable and uncontrollable factor. This study did not include this category, because the pupils' perceptions of their own competencies in mathematics were assumed not to be reflected by the results of a specific test, but rather by their longer-term feelings. Parental support and private educational opportunities have a strong positive influence on children's learning attitudes and mathematics performance (DFE, 1992). Students not only discuss school with their parents but also seek help in doing homework from parents, older siblings and their *juku* teacher (Sawada, et al., 1986, Crystal et al. 1991). Therefore, support at home was included.

Pupils' perceptions of their teachers praising them in mathematics classes

Pupils' perceptions of their teachers praising them in mathematics classes were included as an indirect assessment of goal orientation. They were measured by asking the pupils two questions. The first question concerned to what extent they perceived that their teaching was praised according to four criteria.

- When pupils attain good results in Maths tests, compared to other pupils.
- When pupils have improved results in Maths tests over their previous results.
- When pupils make more effort in Maths, compared to other pupils.
- When pupils make more effort in Maths than they did before.

The second question concerned the extent to which they felt happy with their teacher's praise based on each criterion.

These statements are based on goal theory. The main concept of goal theory is as follows. A mastery goal orientation sees an individual's improvement and progress as success and puts value on effort. Evaluation, within this goal orientation, is based on absolute criteria. On the other hand, a performance orientation indicates striving for better performance than others. Goal orientation is believed to affect the learners' attribution pattern. For instance, a mastery goal orientation leads to an adaptive attribution pattern whereby learners are likely to attribute their failure to lack of effort, while a performance goal orientation leads to a maladaptive attribution pattern whereby learners are likely to attribute their failure to a lack of stable ability. As a result, a mastery goal orientation affects the learners' affect, cognition and behaviour positively, while a performance goal orientation affects them negatively (Anderman et al., 1994; Ames, 1992; Maehr et al., 1991). According to this theory, teachers with a mastery goal orientation are expected to praise students when they show more effort in learning than before, while teachers with a performance goal orientation are likely to praise their students when they get higher marks in a test compared to other students. However, there is doubt concerning the extent to which pupils distinguish whether teachers' praise is based on each orientation and the extent to which they can distinguish their own preferences for teachers' praise in terms of each orientation. Therefore, in this questionnaire design, pupils' perceptions of their teachers' praise and their preferences for teachers' praise were examined in 2 x 2 (performance vs. effort) x (absolute criteria vs. social comparison with others) dimensions. In addition, the design was based on the hypothesis that teachers who generally praise their pupils are likely to do so irrespective of the reasons, while teachers who do not generally praise their pupils are not likely to do so, irrespective of the reasons. Similarly, pupils who seek their teachers' approval are likely to be satisfied with their teachers' praise, irrespective of the reasons, while others are likely to be not satisfied with their teachers' praise, irrespective of the reasons. Therefore, in the questionnaire design, a single-choice reply seemed inappropriate. A five-point rating scale was adopted for each criterion.

Pupils' perceptions of classroom ethos

Fraser's My Class inventory (MCI) (Fraser, 1982) was adopted to assess pupils' perceptions of classroom ethos. The MCI was specifically developed for children in the 8 to 12 years age range. It consists of twenty-five statements across five domains and is very accessible. The five domains are cohesiveness, friction, satisfaction, difficulty and competitiveness. The 'Yes-No' response form is employed because it is easier for younger children to answer than a rating system. MCI is also suitable for junior high school students. The Learning Environment Inventory, Classroom Environment Scale and Individualised Classroom Environment Questionnaire are also used for secondary school students. However, these inventories seemed unsuitable for this study, because of the large numbers of statements. The employment of MCI for both levels appeared to be beneficial in increasing the compatibility between the questionnaire designs for elementary and secondary school pupils. The internal consistency reliability of MCI was reported as being from 0.62 to .78, the discriminant validity of MCI was from 0.10 to 0.26, and its ability to differentiate between classrooms in terms of five domains was at the significance level, $p < .01$. These results show the high validity of this inventory.

Attempts were made to ensure high reliability and validity of standardised instructions in the process of translation, as was the case for SDQ-I and SDQ-II mentioned above. However, two of the original questions appeared difficult for Japanese children to understand, in the pilot studies. The sentence 'Some of the pupils in my class are my friends' in MCI connotes a negative meaning. However, the direct translation of this sentence into Japanese does not necessarily communicate the negative meaning. In the pilot study, children who responded 'Yes' to this statement were often likely to respond 'Yes' also to the statement indicating positive feelings about friendships in mathematics classes, such as 'In my class everybody is my friend'. For this reason, this statement was altered to 'Few pupils in my mathematics classes are my friends'. 'Only the smart pupils can do their work' was also difficult for children to understand. The word 'smartness' is not common among Japanese children who are accustomed to value everyone's mastery learning (Stevenson, 1992). Therefore, this sentence was altered to 'Only certain pupils can always manage their work'. In addition, to ensure asking pupils specifically about the classroom ethos of their mathematics classes the wording 'In my Maths class' was included in every sentence. The statements were ordered as in the original. Table 3.2.5 shows the statements according to five categories.

Table 3.2.5: Statements to ask pupils about their perceptions of classroom ethos

<u>Satisfaction</u>

- The pupils in my Maths class enjoy their work.
- Some pupils are not happy in my Maths class.
- Children seem to like this Maths class.

- Some of the pupils don't like this Maths class.
- Maths class is fun.

Cohesiveness

- In my Maths class everybody is my friend.
- Few pupils in my Maths class are my friends.
- All the pupils in my Maths class are close friends.
- All the pupils in my Maths class like one another.
- Children in our Maths class like each other as friends.

Friction

- Children are always fighting each other in my Maths class.
- Some of the children in my Maths class are mean.
- Many children in this Maths class like to fight.
- Certain pupils always want their own way in my Maths class.
- Children in my Maths class fight a lot.

Difficulty

- In our Maths class the work is hard to do.
- Most of the children in my Maths class can do their work without help.
- Only certain pupils in my Maths class can do their work.
- Schoolwork in Maths class is hard to do.
- Most of the pupils in my Maths class know how to do their work.

Competitiveness

- Children often race to see who can finish first in my Maths class.
- Most of the children in my Maths class want their work to be better than their friends' work.
- Some pupils in my Maths class feel bad when they don't do as well as the others.
- Some pupils always try to do their work better than the others in my Maths class.
- A few children in my Maths class want to be first all the time.

3.3: The design of the questionnaire for teachers

The questionnaire for teachers aimed to obtain their perceptions of five aspects of their mathematics classes. The first concerned teachers' reports on the frequency of use of particular teaching methods and their perceptions of their pupils' attitudes towards learning mathematics in relation to these methods. The second concerned the teachers' attempts to enhance their pupils' self-concepts and mathematics efficacy. The third concerned their attributions of their pupils' mathematics outcomes. The fourth concerned how they perceived their pupils in mathematics classes. The fifth concerned their perceptions of classroom ethos and their attempts to improve this ethos. These were compatible with the issues raised in the pupils' questionnaire.

Two pilot studies were conducted in developing the questionnaire for teachers, before the main survey. Attempts were made to ensure compatibility between the questionnaire for pupils and that for teachers as far as possible. The first pilot study was conducted with 15 teachers, using a self-administered questionnaire. Afterwards, interviews were conducted with individual teacher participants, to further explore their views on the questions and establish any difficulties and limitations in the questionnaire design. Teachers working at junior high schools who specialised in mathematics were more likely to have developed specific views on mathematics education, while teachers working in elementary schools teaching all the curriculum subjects were more likely to see mathematics education as linked with other subjects. Questions were designed to ensure the accessibility of questions for both teacher groups. The second pilot study was conducted with those teachers assisting with the pupils' third and fourth pilot study, to ensure that the altered questions were accessible for teachers of both teaching age groups.

The first pilot study with teachers examined the appropriateness of the teaching methods described in the questionnaire. The questionnaire contained those teaching methods which were selected following the recommendations of the Ministry of Education in Japan (1999), with 'Others, specify' questions. Afterwards, the researcher interviewed individual participants in the pilot study. Originally, two other teaching methods in mathematics classes were included. One was teaching mathematics through pupils' writing. Although this method is becoming popular in other countries (e.g. Pugalee, 1996, 1998), and some teachers in Japanese schools are also attempting to introduce it in their mathematics classes, it was completely unfamiliar to the majority of the teachers taking part in the pilot study. Therefore, it was excluded. Watching TV/video was encouraged as a method of teaching in the 1970s and 1980s. TV was available in 98.1%

of elementary schools and 94.3% of junior high schools in 1983 and utilised as one of the most prevailing instructional aids (National Institute for Educational Research, 1983). However, with the emphasis on the introduction of learning mathematics with computers, learning mathematics through TV/video has been less encouraged. For example, many teachers mentioned that the TV/video facilities, which had been put in the classroom a decade ago, had been removed. Therefore, the extent to which teachers can use watching TV/video as a mathematics teaching method mainly depends on external factors rather than the teachers' choice. While the Course of Study 2002 encourages the employment of audio educational instruments in classrooms generally, the use of audio educational instruments in mathematics classrooms is not specifically mentioned. For this reason, watching TV/video was not included in this study. The words indicating the teaching methods were identical to those used for the pupils. Statements were devised to communicate to teachers that they aimed to measure their pupils' attitudes towards learning mathematics as promoted by the different teaching methods used in mathematics classes. A five-point rating system was employed as the form of response, identical to that used for the pupils. The statements asking teachers the frequency of use of different teaching methods and their perceptions of their pupils' attitudes towards learning mathematics promoted by the different teaching methods were as follows.

- How often do you use these teaching methods in your mathematics lessons?
- Do these methods help your pupils to enjoy learning mathematics?
- Do these methods encourage your pupils to try hard in mathematics?
- Do you think your pupils feel relaxed in learning mathematics when you use these particular methods?
- Do you think these methods help your pupils to feel a sense of progress in learning mathematics?

Teachers of both age groups were required to express in their own words their opinions as to why they thought any particular aspect of their pupils' attitudes towards learning mathematics was promoted by a particular teaching method. The statements adopted in the teachers' questionnaire were as follows.

- Why do you think particular teaching methods enable your pupils to enjoy learning mathematics?
- Why do you think particular teaching methods encourage your pupils to try hard in mathematics?

- Why do you think particular teaching methods enable your pupils to feel relaxed in learning mathematics by using these methods?
- Why do you think these methods help your pupils to feel a sense of progress in learning mathematics?

The statement, which measured the teachers' attempts to enhance their pupils' self-concept was, 'How often do you attempt to enhance your pupils' self-concept or self-confidence in your mathematics classes?' In addition, the statement, which measured the teachers' attempts to enhance their pupils' mathematics concept was, 'How often do you attempt to enhance your pupils' positive attitudes towards mathematics learning in your mathematics classes?' These statements adopted the five point rating scale: *always, nearly always*, *sometimes, hardly ever* and *never.*

Teachers' attributions of their pupils' success or failure in learning mathematics was measured with open questions. Teachers were required to express their opinions by answering two questions, 'Why do you think some pupils succeed in learning mathematics?', and 'Why do you think some pupils fail to learn mathematics?' Enquiring about teachers' attributions of their pupils' success and failure separately aimed to explore the hypothesis that teachers may have different attributions of their pupils' success in learning mathematics and failure in learning mathematics, due to the self-serving system, discussed in the literature review (Pintrich, 1996).

Teachers were asked how often they praised their pupils, according to four criteria. These were based on 'mastery goals' and 'performance goals', and were identical to those used for the questionnaire for pupils. Five point rating scales were adopted: *always, nearly always, sometimes, hardly ever,* and *never.* The statements indicating the four criteria were as follows.

- When pupils get good results in Maths tests, compared to other pupils.
- When pupils have improved their results in Maths tests from previous results.
- When pupils make more effort in Maths, compared to other pupils.
- When pupils make more effort in Maths than before.

Teachers' perceptions of classroom ethos were measured with five-point rating scales. Fraser's (1986) synthesis showed that satisfaction in classes was positively related with pupils' attainments, while difficulties in the classes were negatively related with their attainments (Fraser, et al., 1982a, 1982b). Although Fraser's (1986) synthesis reported that the relationship between cohesiveness and the pupils' attainments were unclear, the Ministry of Education in Japan (1999) encouraged teachers to build good peer relationships in mathematics classes. Therefore, teachers were asked how often they attempted to enhance their pupils' satisfaction in learning mathematics, promoted co-operative attitudes between pupils and reduced their pupils' difficulties in learning mathematics.

The statements measuring the teachers' perceptions of competitiveness and friction were developed during the pilot study. Fraser's (1986) synthesis indicated that competitiveness among pupils in the classroom would lead to less favourable outcomes (Talmage, et al., 1978) or no-significant effect (Fraser, et al., 1985). Therefore, originally, the questions regarding competition enquired about the frequency of teachers' attempts to reduce competition among pupils. However, some of the teachers taking part in the pilot-study mentioned that competition among pupils could, in some cases, work as a measure for promoting pupils' motivation to learn mathematics. If many Japanese teachers adopt such perspectives, asking teachers to what extent they are attempting to reduce competition in classes, which is based on the assumption that competition should be reduced is biased by the researcher's subjectivity. In the second pilot study, some respondents expressed their agreement that competition should be used as a means to promote pupils' motivation to mathematics. Therefore, a question, which asked the teachers whether they thought that competition between pupils could be used to enhance pupils' motivation to learn mathematics, was adopted in the main study.

The question regarding friction between pupils was, originally, about the extent to which teachers were attempting to reduce such friction. This was because Fraser's (1985) study showed a negative correlation between friction in the classroom and pupils' attainment. Such a question might be viewed as parallel to the questions concerning to what extent teachers were attempting to improve their pupils' satisfaction in learning mathematics, promote co-operative attitudes among pupils and reduce their pupils' difficulties in learning mathematics. However, the teachers taking part in the pilot study mentioned that they had rarely seen friction among pupils in their mathematics classes. Thus, the 'hardly ever' or 'never' responses to the question, 'Do you attempt to reduce friction between your pupils?' might produce two interpretations. One, that the teacher would not need to attempt to reduce such friction, the other, that the teacher would not attempt to reduce friction between pupils even if they observed it. Therefore, a question, which asked teachers how often they noticed friction between pupils in their mathematics classes, was included in the main study. The statements were as follows:

- How often do you attempt to enhance your pupils' satisfaction in learning mathematics?
- How often do you attempt to promote co-operative attitudes among pupils?
- How often do you attempt to reduce your pupils' difficulties in learning mathematics?
- To what extent do you agree that competition can be used to promote pupils' motivation to learn mathematics?
- How often do you notice friction between pupils in mathematics classes?

3.4: The design of the interview sheet for teachers

Although the study employed a questionnaire survey as the main resource to explore teachers' and pupils' perceptions, perceptions were also assessed qualitatively, through open questions whereby the participants wrote responses in their own words. This was employed for the teachers of both age groups and 8^{th} graders. In addition, the study employed an interview technique with teachers as a follow-up. It aimed to widen the range of questions asked, deepen understanding of the information obtained in the questionnaire survey, and explore why the teachers were likely to perceive in a particular way. Before the main data collection, a pilot study for the teachers' interview schedule was conducted with three elementary school teachers working with 5^{th} graders, drawn from those helping to conduct the pupils' main survey. This pilot study was conducted in the form of a group interview, to examine to what extent deeper information would be gained by conducting the interviews. Teachers taking part in the pilot study showed a deep understanding of the issues. Three main questions were explored in the teachers' interview.

1. Teachers' perceptions of pupils' affective attitudes towards mathematics learning.
2. Teachers' perceptions of the teaching methods used in mathematics classes.
3. Teachers' agreement on using various kinds of teaching methods in mathematics classes and their justification.

Regarding the first main question, teachers were asked whether they thought that promoting pupils' affective attitudes towards mathematics learning was important in their mathematics classes. The investigation was conducted regarding each facet of attitudes separately. The study started with the assumption that the promotion of pupils' affective attitudes is important, as described in Chapter 1. The first question examined whether teachers taking part in this study supported this assumption as this would be important in Interpreting the data. The question adopted was:

- Do you think that promoting pupils' enjoyment in learning mathematics is important in mathematics classes? Could you explain your response?

Teachers were asked about their perspectives regarding the importance of promotion of each of the four facets, i.e. enjoyment, motivation, sense of security and sense of progress, respectively. The second question explored the ways teachers assess pupils' affective attitudes towards mathematics learning. The question asked:

- Can you assess whether pupils are enjoying learning mathematics in your classes? How do you assess it?

Teachers were asked about these points regarding each individual facet of pupils' enjoyment, motivation and sense of security. The question, which asked the teachers about their definition of pupils' feelings of progress was taken up, based on the pilot study. This was because the teachers taking part in the pilot study thought that the understanding of a sense of progress they expected their pupils to have would not be the same as their own. The statements regarding pupils' sense of progress were:

- When do you think your pupils develop a sense of progress?
- When do you suppose your pupils feel that their sense of progress is being promoted?

Regarding the second main question, teachers were asked to what extent they adopted each teaching method in their mathematics classes. The study explored eight teaching methods; practical work, using computers, reading a textbook, teacher explanation, individual teaching methods, and discussion. The questions adopted in the interview were:

- Do you sometimes use practical activities?

Teachers were required to reflect their practices while examining the advantages and disadvantages of each teaching method.

Regarding the third question, teachers were asked whether they thought employing a variety of teaching methods in mathematics classes was effective for promoting pupils' affective attitudes towards mathematics learning. They were also asked to justify their views. This question was designed to elucidate teachers' perceptions of the main themes taken up in the study, whether pupils' affective attitudes towards mathematics learning can be promoted through widening the range of teaching methods deployed in mathematics classes. The question adopted was:

- Do you think that employing various kinds of teaching methods in mathematics classes is effective in promoting pupils' affective attitudes towards mathematics l7earning? Please explain your answer.

3.5: The data collection

The sample in the questionnaire survey consisted of 48 5th grade teachers and 1479 of their pupils belonging to 28 elementary schools, and 42 8th grade teachers and 2156 of their pupils belonging to 19 junior high schools in Tokyo. The researcher sent a letter of enquiry to the head teachers of all the state elementary and junior high schools located in four wards of Tokyo, and the private junior high schools located in Tokyo and its suburbs, in June 1999. In July and August 1999 they replied to the researcher to confirm their willingness to take part in the survey. The main research was conducted, with all the schools, which expressed their willingness to take part in the survey, from September to November 1999. All the students in these schools, except those who were absent from school on the research day, took part in the questionnaire survey. Almost all of the teachers teaching these students took part in the questionnaire survey. Afterwards, one third of the teachers taking part in the questionnaire survey took part in the interviews, in December 1999. The number of participants interviewed was 31.

Participant schools were selected only on the basis of their location. There may have been some bias because the teachers, who expressed their willingness for their pupils and themselves to take part in the survey might have had a higher interest in promoting pupils' positive attitudes towards learning mathematics and adopting different teaching methods in mathematics classes than other teachers. The generalisability of the findings of this study might therefore be limited.

A group-administered questionnaire with teachers reading aloud, was conducted with 5th graders. This research method was trialled in the third pilot study with 5th graders; and was found to help the children to participate more easily. The questionnaire could be completed within one class duration. This was ensured through the pilot study. Group-administered questionnaires under the teacher's supervision were administered to 8th graders. The researcher attended each administration to both 5th and 8th graders to ensure that both grades took part in the survey without any difficulties. The teachers' questionnaire survey employed a self-administered questionnaire. This method aimed to ensure a high response rate, accurate sampling and a minimum of interview bias, while providing necessary explanations and the benefit of a degree of personal contact (Oppenheim, 1996).

The teacher interviews were conducted with individual teachers with no other colleagues present. This aimed to reduce the possibility of social desirability bias (Oppenheim, 1996), which was more likely to occur in a group interview with colleagues than an individual interview. The individual interview also aimed to minimise hesitation over stating views. The individual interviews took from 20 minutes to one hour. All interviews were tape-recorded.

3.6: The data analysis

The quantitative data obtained in the questionnaires were analysed using SPSS. The data analysis was conducted, to focus on the comparisons between groups: between teachers and pupils of each grade, teachers according to their teaching age groups, and pupils according to their age groups.

Qualitative data were obtained from the responses to the open questions in the questionnaire of 8th graders and teachers of both age groups. The responses of teachers of both teaching age groups were compared. The responses of 8th graders and their teachers were also compared. The qualitative data obtained in the questionnaire survey were analysed adopting procedures, as proposed by Cooper et al. (1993). Cooper et al. (1993) defines a seven-stage process for this analysis (Marton, 1990). The details of the procedures will be presented at the beginning of the presentation of the data analysis. Compared to quantitative analysis, qualitative enquiry has looser controls, may reflect greater individual bias, reduce comparability across studies, and may also be less reliable and more affected by the subjective opinions of the people studied (Coolican, 1994). However, qualitative studies offer greater ecological validity, though they may lack validity in other respects. To reduce researcher bias, two persons (the researcher and a Japanese researcher) coded the findings independently. Where there was initial disagreement over coding discussion was undertaken to reach agreement.

All data obtained in the interviews were transcribed and translated from Japanese to English. Responses were categorised. The statements supporting the categories were extracted. Comparisons were made between 5th grade teachers and 8th grade teachers.

CHAPTER 4: COMPARISON OF TEACHERS' AND PUPILS' PERCEPTIONS OF PUPILS' ATTITUDES TOWARDS LEARNING MATHEMATICS AS REFLECTED IN THEIR PERCEPTIONS OF THE TEACHING METHODS DEPLOYED IN MATHEMATICS CLASSES

This chapter presents the results of the data analysis of the questionnaire related to Research Question 1. This required a comparison of the perceptions of teachers and pupils belonging to 5^{th} and 8^{th} grade regarding the pupils' attitudes towards learning mathematics, in relation to their perceptions of the teaching methods used in mathematics classes. This analysis explores four aspects of pupils' attitudes towards learning mathematics: enjoyment, motivation, a sense of security and a sense of progress.

- *Enjoyment* indicates the extent to which pupils enjoy learning mathematics.
- *Motivation* indicates the extent to which they feel that they want to try hard in learning mathematics.
- *A sense of security* indicates the extent to which pupils feel relaxed and comfortable about learning mathematics.
- *A sense of progress* indicates the extent to which pupils feel they are making progress in learning mathematics.

Pupils' and teachers' perceptions of the extent of deployment of different teaching methods were also examined. Eight teaching methods, as recommended by the Ministry of Education in Japan (1999) for use in mathematics classes, were considered. These were *Practical work*, *Using a computer, Reading a textbook*, *Teacher explanation*, *Individual work*, *Individual help from the teacher*, *Whole-class discussion* and *Group discussion*. The questionnaire survey for both teachers and pupils used five-point rating scales. For pupil attitudes towards learning mathematics in terms of teaching methods from 5 to 1: *absolute agreement, agreement*, *neither agreement nor disagreement*, *disagreement* and *absolute disagreement*. And for pupils' perceptions of the frequency of different methods from 5 to 1: *always, nearly always, sometimes, hardly every* and *never.*

4.1: Descriptive statistics of the participants' perceptions

4.1.1: Descriptive statistics of the responses of 5th grade teachers

Enjoyment

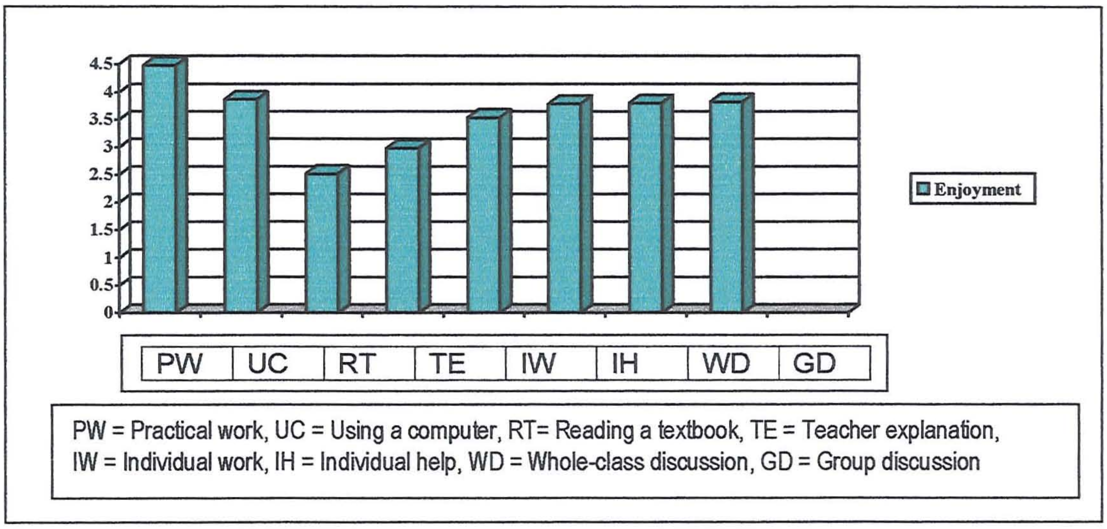
Table 4.1.1 and Figure 4.1.1 outline the responses. They show that the teachers believed that *Practical work* promoted their pupils' enjoyment in learning mathematics the most ($4 \leq M < 5$). They expressed neither agreement nor disagreement ($3 \leq M < 4$) that *Using a computer, Individual work, Individual help, Whole-class discussion,* and *Group discussion* promoted their pupils' enjoyment, and disagreement ($2 \leq M < 3$) that *Reading a textbook* and *Teacher explanation* promoted enjoyment. The results of a repeated measure ANOVA showed that these differences were statistically significant.

Table 4.1.1: Mean scores and Standard Deviation; enjoyment; perceptions of 5th grade teachers

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	48	47	48	48	48	48	48	48
M	4.48	3.87	2.52	2.98	3.54	3.79	3.81	3.83
SD	.58	.90	.87	.79	.74	.85	.82	.69

The result of a repeated measure ANOVA [$F(8,368)=26.60$, $p<.01$]

Figure 4.1.1: Pupils' enjoyment promoted by different teaching methods; perceptions of 5th grade teachers



Motivation

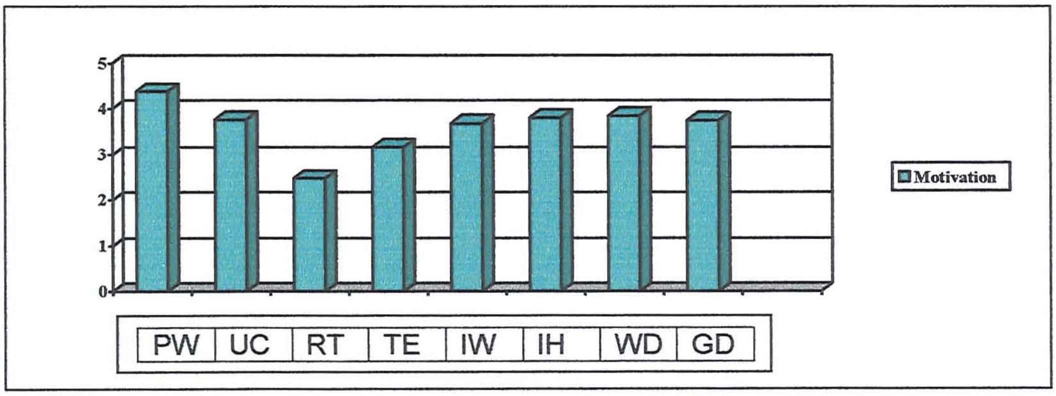
When motivation was explored, 5th grade teachers expressed their agreement (4≤M<5) that *Practical work* promoted their pupils' motivation to learn mathematics the most (see Table 4.1.2 and Figure 4.1.2). They expressed neither agreement nor disagreement (3≤M<4) that *Using a computer, Teacher explanation, Individual work, Individual help, Whole-class discussion,* and *Group discussion* promoted motivation and disagreement (2≤M<3) that *Reading a textbook* promoted motivation. The results of a repeated measure ANOVA showed that these differences were statistically significant. There was a wider distribution for responses to *Using a computer,* suggesting that there was less consensus on this point.

Table 4.1.2: Mean scores and Standard Deviation; motivation; perceptions of 5th grade teachers

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	48	48	48	47	48	48	48	48
M	4.38	3.77	2.48	3.17	3.69	3.81	3.85	3.75
SD	.79	1.04	.95	.89	.75	.94	.87	.81

The result of a repeated measure ANOVA [F (8,368)=24.81, p<. 01]

Figure 4.1.2: Pupils' motivation promoted by different teaching methods; perceptions of 5th grade teachers



A sense of security

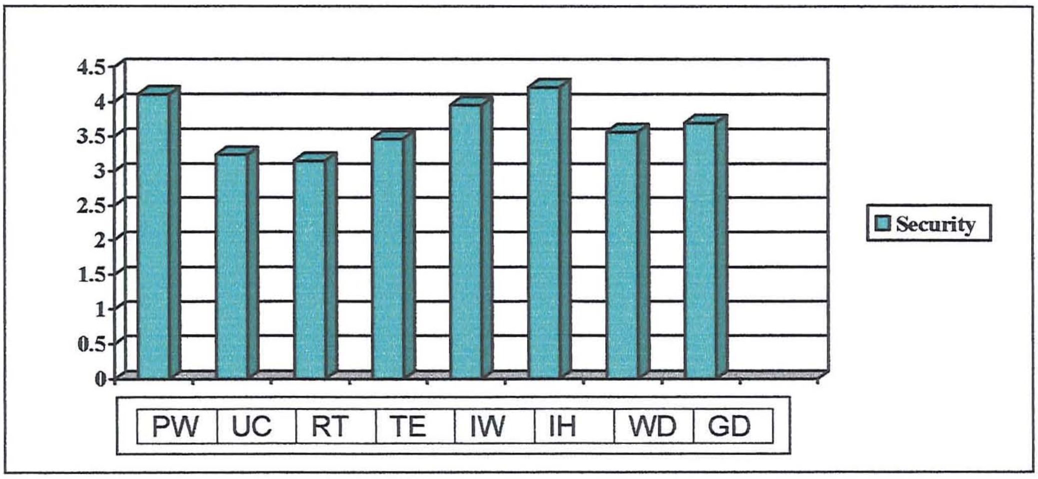
In relation to promoting pupils' sense of security, 5th grade teachers expressed their agreement (4≤M<5) that *Practical work* and *Individual help* promoted their pupils' sense of security in learning mathematics (Table 4.1.3 and Figure 4.1.3). They expressed neither agreement nor disagreement (3≤M<4) that *Using a computer, Reading a textbook, Teacher explanation, Individual work, Whole-class discussion,* and *Group discussion* promoted a sense of security. The results of a repeated measure ANOVA showed that these differences were statistically significant. There was a relatively large distribution (1.0<SD) for *Teacher explanation.*

Table 4.1.3: Mean scores and Standard Deviation; a sense of security; perceptions of 5th grade teachers

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	47	46	47	47	47	47	47	47
M	4.11	3.24	3.15	3.47	3.96	4.21	3.57	3.70
SD	.67	.85	.93	1.02	.72	.81	.71	.72

The result of a repeated measure ANOVA [$F(8,360)=15.64$, $p<.01$]

Figure 4.1.3: Pupils' sense of security promoted by different teaching methods; perceptions of 5th grade teachers



A sense of progress

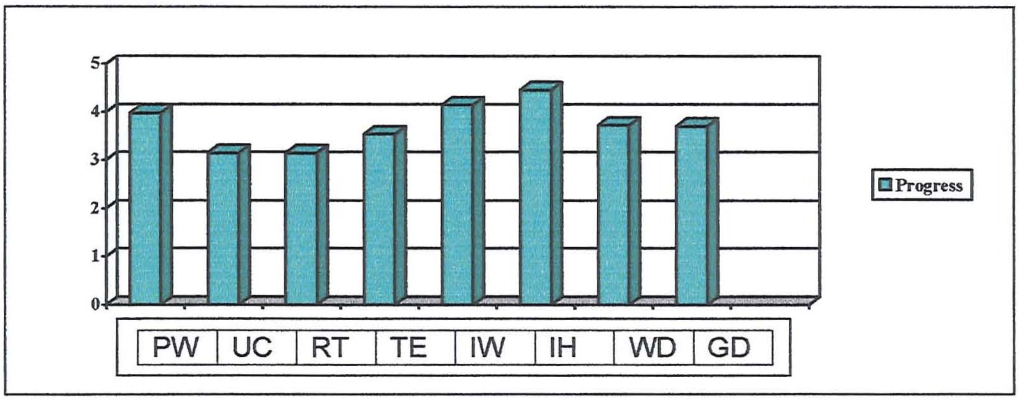
Table 4.1.4 and Figure 4.1.4 below show that 5th grade teachers expressed their agreement (4≤M<5) that *Individual work* and *Individual help* promoted their pupils' sense of progress in learning mathematics, closely followed by *Practical work*. They expressed neither agreement nor disagreement (3≤M<4) that *Using a computer, Reading a textbook, Teacher explanation, Whole-class discussion* and *Group discussion* promoted their pupils' sense of progress in learning mathematics. The results of a repeated measure ANOVA showed that these differences were statistically significant. Compared with the findings for sense of security and motivation there is a greater consensus in teacher beliefs here.

Table 4.1.4: Mean scores and Standard Deviation; a sense of progress; perceptions of 5th grade teachers

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	48	47	48	48	48	48	48	48
M	3.98	3.15	3.15	3.54	4.15	4.46	3.73	3.71
SD	.73	.72	.85	.77	.68	.77	.76	.77

The result of a repeated measure ANOVA [$F(8,368)=25.30$, $p<.01$]

Figure 4.1.4: Pupils' sense of progress promoted by different teaching methods; perceptions of 5th grade teachers



Deployment of different teaching methods

Table 4.1.5 and Figure 4.1.5 below show that *Teacher explanation, Individual work,* and *Individual help* were nearly always (4≤M<5) deployed by the teachers. They reported that *Reading a textbook* and *Whole-class discussion* were sometimes (3≤M<4) deployed and that *Practical work* and *Group discussion* were hardly ever (2≤M<3) deployed. They reported that *Using a computer* was never (1≤M<2) deployed in their mathematics classes. The results of a repeated measure ANOVA showed that these differences were statistically significant. There was a relatively large distribution (1.0<SD) for *Reading a textbook* and *Whole-class discussion.* Previous sections show that the 5th grade teachers indicated overall that they believed that *Individual work, Individual help* and *Practical work* were the most likely to positively promote each of the four attitudinal

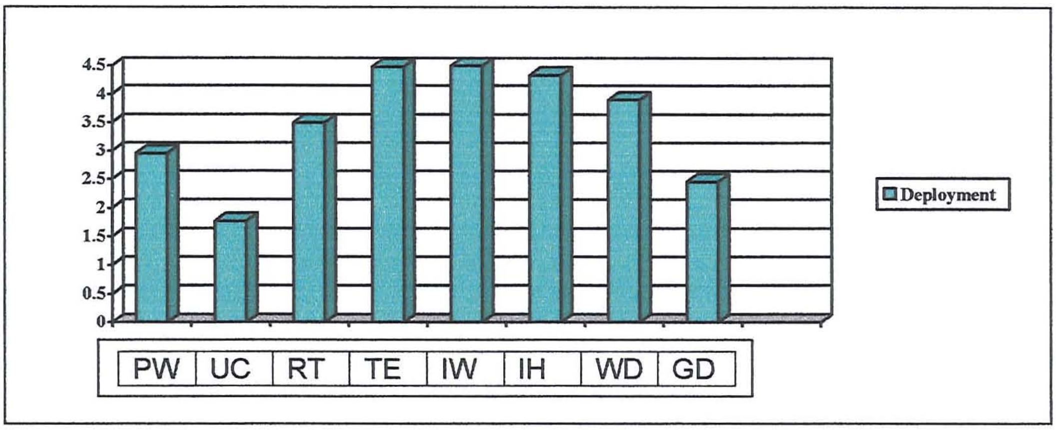
responses of pupils to learning mathematics. While *Individual work* and *Individual help* were reported to be deployed extensively in their classes this was not the case for *Practical work*, although it was this which was seen as most likely to promote enjoyment and motivation. *Using a computer* was also rated highly in relation to promoting motivation and enjoyment. It was rarely deployed.

Table 4.1.5: Mean scores and Standard Deviation; deployment; perceptions of 5th grade teachers

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	48	48	48	48	48	48	48	48
M	2.96	1.77	3.50	4.48	4.50	4.33	3.90	2.46
SD	.77	.78	1.11	.65	.65	.63	1.06	.92

The result of a repeated measure ANOVA [F (8,376)=104.27, p<. 01]

Figure 4.1.5: Deployment of different teaching methods in mathematics classes; perceptions of 5th grade teachers



Summary

Table 4.1.6: Summary of the perceptions of 5th grade teachers

	Enjoyment	Motivation	A sense of security	A sense of progress	Deployment
M=5					
4≤M<5	Practical work	Practical work	Practical work Individual help	Individual work Individual help	Teacher explanation Individual work Individual help
3≤<M<4	Using a computer Individual work Individual help Whole-class discussion Group discussion	Using a computer Teacher explanation Individual work Individual help Whole-class discussion Group discussion	Using a computer Reading a textbook Teacher explanation Individual work Whole-class discussion Group discussion	Practical work Using a computer Reading a textbook Teacher explanation Whole-class discussion Group discussion	Reading a textbook Whole-class discussion
2≤<M<3	Teacher explanation Reading a textbook	Reading a textbook			Practical work Group discussion
1≤<M<2					Using a computer

The findings from the 5th grade teachers show that different teaching methods are perceived to promote pupils' attitudes differently. In addition there were large differences in the extent to which the different methods were deployed.

The teaching methods deployed in mathematics classes most frequently, *Individual work* and *Individual help,* were perceived by the teachers to promote a sense of progress and a sense of security, but not to promote enjoyment or motivation. *Teacher explanation*, which was frequently deployed, was perceived to be at best neutral in positively promoting attitudinal aspects. A wide distribution existed in the extent to which *Teacher explanation* was believed to promote pupils' sense of security. *Reading a textbook* was sometimes deployed, but was perceived as negative in promoting pupils' enjoyment and motivation. However, there was a wide distribution of responses.

Whole-class discussion was sometimes deployed, although there was considerable variation between teachers. *Group discussion* was deployed less than *Whole-class discussion*. The teachers perceived that both discussion-style teaching methods were neutral in promoting pupils' positive affective attitudes. *Practical work,* which was perceived to promote enjoyment, motivation and sense of security, was hardly ever deployed.

Overall the teachers reported that *Using a computer* was never deployed in their mathematics classes. Generally, it was perceived as neutral in promoting pupils' affective attitudes. However, there was wide variation in the extent to which it was believed to affect motivation.

4.1.2: Descriptive statistics of the responses of 8th grade teachers

Enjoyment

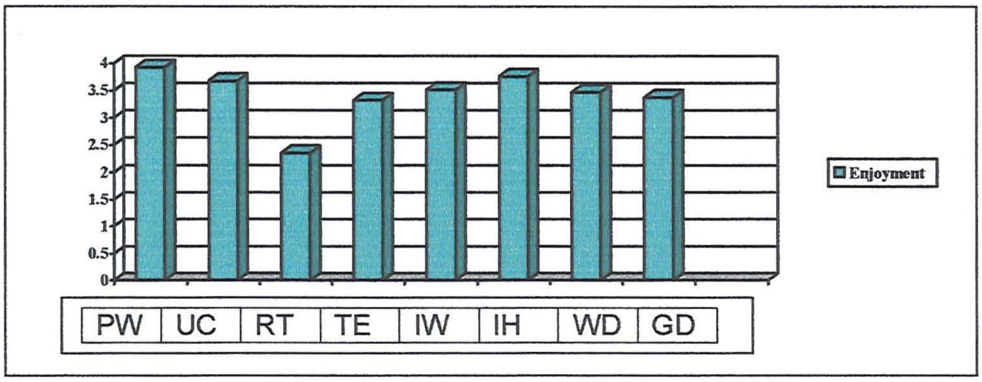
8th grade teachers expressed neither agreement nor disagreement ($3 \leq M < 4$) that *Practical work, Using a computer, Teacher explanation, Individual work, Individual help, Whole-class discussion* and *Group discussion* promoted their pupils' enjoyment in learning mathematics, although *Practical work* and *Individual help* received the most positive responses. They expressed disagreement ($2 \leq M < 3$) that *Reading a textbook* promoted enjoyment. These differences were statistically significant. A large distribution (SD<1.0) existed in their perceptions of the extent to which *Practical work* and *Using a computer* promoted enjoyment. Overall, 8th grade teachers tended to believe that none of the teaching methods in common use promoted enjoyment in their students (see Table 4.1.7 and Figure 4.1.6).

Table 4.1.7: Mean scores and Standard Deviation; enjoyment; perceptions of 8th grade teachers

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	42	40	42	42	42	42	42	42
M	3.93	3.68	2.36	3.33	3.52	3.76	3.48	3.38
SD	1.05	1.00	.93	.79	.71	.82	.71	.79

The result of a repeated measure ANOVA [F (8,312)=11.68, p<. 01]

Figure 4.1.6: Pupils' enjoyment promoted by different teaching methods; perceptions of 8th grade teachers



Motivation

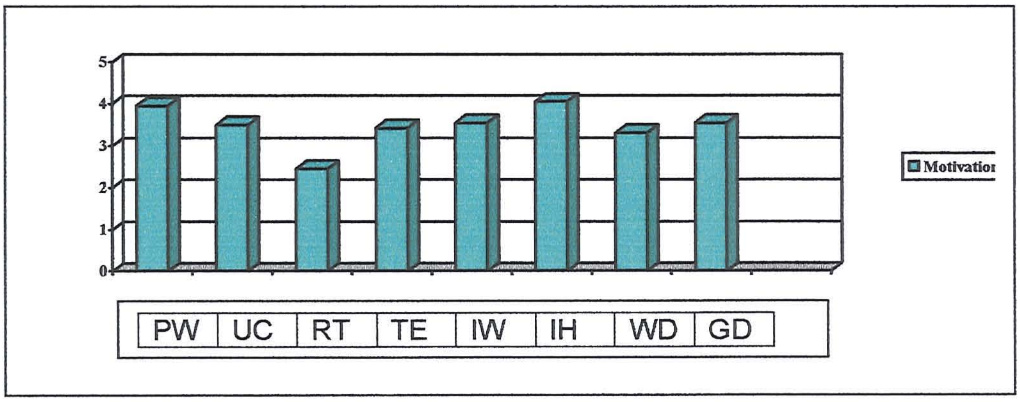
Table 4.1.8 and Figure 4.1.7 below show that on average 8th grade teachers believe (4≤M<5) that *Individual help* promoted their pupils' motivation. They expressed neither agreement nor disagreement (3≤M<4) that *Practical work, Using a computer, Teacher explanation, Individual work, Whole-class discussion* and *Group discussion* promoted motivation. Of these the most likely to promote motivation were *Individual help* and *Practical work.* They disagreed (2≤M<3) that *Reading a textbook* promoted motivation. The results of a repeated measure ANOVA showed that these differences were statistically significant. Overall, few of the teaching methods adopted were perceived as likely to promote motivation, the exception being *Individual help.*

Table 4.1.8: Mean scores and Standard Deviation; motivation; perceptions of 8th grade teachers

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	42	40	42	42	42	42	42	42
M	3.95	3.50	2.45	3.43	3.55	4.05	3.31	3.55
SD	.76	.78	.94	.74	.63	.73	.84	.86

The result of a repeated measure ANOVA [F (8,312)=15.75, p<. 01]

Figure 4.1.7: Pupils' motivation promoted by different teaching methods; perceptions of 8th grade teachers



A sense of security

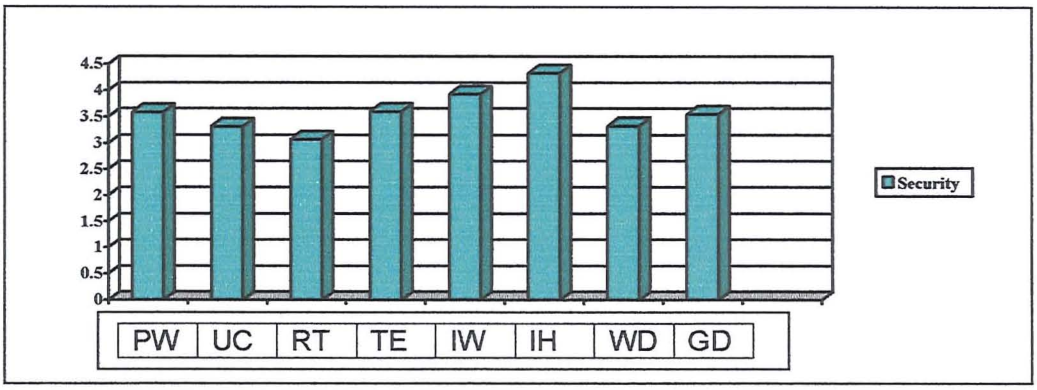
Table 4.1.9 and Figure 4.1.8 below show that on average 8th grade teachers believed (4≤M<5) that *Individual help* promoted their pupils' sense of security in learning mathematics most. They expressed neither agreement nor disagreement (3≤M<4) that *Practical work, Using a computer, Reading a textbook, Teacher explanation, Individual work, Whole-class discussion* and *Group discussion* promoted a sense of security. Of these the most positive responses were in relation to *Individual help,* followed by *Individual work.* The results of a repeated measure ANOVA showed that these findings were statistically significant. There was greater variation in responses for *Reading a textbook.*

Table 4.1.9: Mean scores and Standard Deviation; a sense of security; perceptions of 8th grade teachers

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	39	38	40	40	40	40	40	40
M	3.59	3.32	3.08	3.60	3.93	4.33	3.33	3.55
SD	.82	.66	1.00	.78	.76	.73	.73	.78

The result of a repeated measure ANOVA [F (8,288)=10.97, p<. 01]

Figure 4.1.8: Pupils' sense of security promoted by different teaching methods; perceptions of 8th grade teachers



A sense of progress

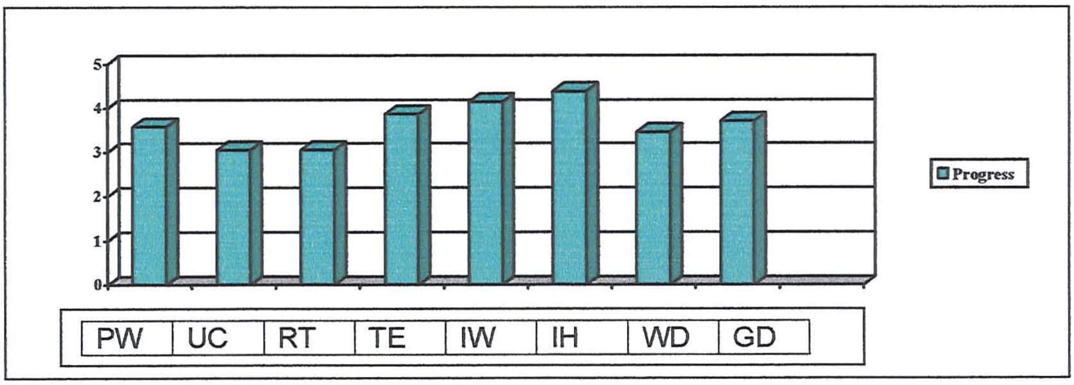
Table 4.1.10 and Figure 4.1.9 below show that 8th grade teachers believed (4≤M<5) that *Individual work* and *Individual help* most promoted their pupils' sense of progress in learning mathematics. They expressed neither agreement nor disagreement (3≤M<4) that *Practical work, Using a computer, Reading a textbook, Teacher explanation, Whole-class discussion* and *Group discussion* promoted sense of progress. The result of a repeated measure ANOVA showed that these findings were statistically significant.

Table 4.1.10: Mean scores and Standard Deviation; a sense of progress; perceptions of 8th grade teachers

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	42	40	42	42	42	42	42	42
M	3.57	3.05	3.05	3.86	4.14	4.38	3.45	3.71
SD	.83	.81	.94	.72	.78	.62	.74	.71

The result of a repeated measure ANOVA [F=(8,312)=19.76, p<. 01]

Figure 4.1.9: Pupils' sense of progress promoted by different teaching methods; perceptions of 8th grade teachers



Deployment of different teaching methods

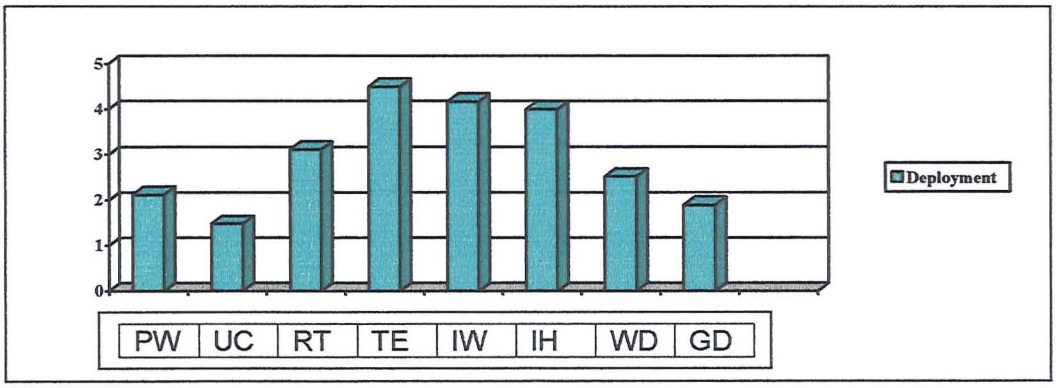
Table 4.1.11 and Figure 4.1.10 below show that 8th grade teachers reported that *Teacher explanation, Individual work,* and *Individual help* were nearly always ($4 \leq M < 5$) deployed in their mathematics classes. *Reading a textbook* was sometimes ($3 \leq M < 4$) deployed, while *Practical work* and *Whole-class discussion* were hardly ever ($2 \leq M < 3$) deployed. *Using a computer* and *Group discussion* were never ($1 \leq M < 2$) deployed. These findings were statistically significant. A relatively large distribution ($1.0 < SD$) existed in relation to the frequency of deployment of *Reading a textbook, Whole-class discussion,* and *Group discussion,* suggesting considerable variation between teachers in the use of these methods. Overall, the most commonly deployed method, *Teacher explanation,* was not perceived as being highly beneficial in positively promoting any of the pupils' attitudinal responses.

Table 4.1.11: Mean scores and Standard Deviation; deployment; perceptions of 8th grade teachers

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	42	42	42	42	42	42	42	42
M	2.12	1.48	3.12	4.50	4.17	4.00	2.52	1.90
SD	.86	.74	1.27	.67	.73	.86	1.13	1.01

The result of a repeated measure ANOVA [$F(8, 328)=81.12$, $p<.01$]

Figure 4.1.10: Deployment of different teaching methods in mathematics classes; perceptions of 8th grade teachers



Summary

Overall, the findings from 8th grade teachers show that the different teaching methods deployed in mathematics classes are perceived to impact on pupils' affective attitudes towards mathematics learning differently. There were substantial differences in the extent to which the different methods were used.

The pattern of perceptions of 8th grade teachers was very similar to that of 5th grade teachers. *Individual work* and *Individual help*, which were perceived to promote a sense of progress, were frequently deployed. *Individual help* was perceived to promote motivation and a sense of security as well. *Teacher explanation*, which was frequently deployed, was perceived to be at best neutral in promoting positive attitudes towards learning mathematics. *Reading a textbook* was sometimes deployed, but was perceived as not promoting enjoyment or motivation. There was a wide distribution in the extent to which *Reading a textbook* was seen to promote pupils' sense of security and the extent to which individual teachers deployed this method.

Although the teachers perceived that *Practical work* was neutral in promoting positive affective attitudes towards mathematics learning, this teaching method was hardly ever deployed in classes. Discussion-style teaching methods were reported to be deployed less frequently at 8th grade than 5th grade. *Whole-class discussion* was hardly ever deployed, and *Group discussion* on average never deployed. However, there was wide variation between teachers in the reported frequency of deployment of these teaching methods.

Overall *Using a computer* was reported as never being deployed in mathematics classes. It was perceived that this teaching method was, overall, neutral in promoting pupils' affective attitudes towards mathematics learning. However, there was considerable individual variation in these responses (Table 4.1.12).

Table 4.1.12: Summary of the perceptions of 8th grade teachers

	Enjoyment	Motivation	A sense of security	A sense of progress	Deployment
M=5					
4≤M<5		Individual help	Individual help	Individual work Individual help	Teacher explanation Individual work Individual help
3≤M<4	Practical work Using a computer Teacher explanation Individual work Individual help Whole-class discussion Group discussion	Practical work Using a computer Teacher explanation Individual work Whole-class discussion Group discussion	Practical work Using a computer Reading a textbook Teacher explanation Individual work Whole-class discussion Group discussion	Practical work Using a computer Reading a textbook Teacher explanation Whole-class discussion Group discussion	Reading a textbook
2≤M<3	Reading a textbook	Reading a textbook			Whole-class discussion Practical work
1≤M<2					Group discussion Using a computer

4.1.3: Descriptive statistics of the responses of 5th graders

Enjoyment

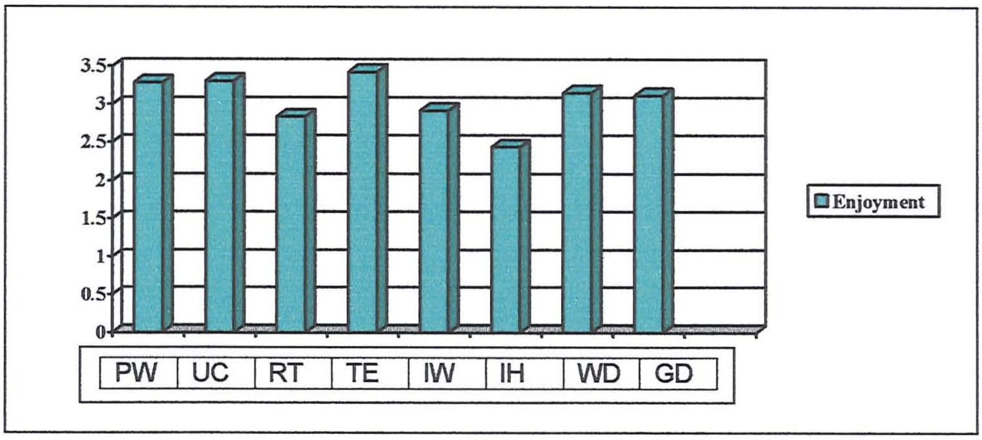
Table 4.1.13 and Figure 4.1.11 below show that 5th graders expressed neither agreement nor disagreement (3≤M<4) that *Practical work, Using a computer, Teacher explanation, Whole-class discussion,* and *Group discussion* promoted their enjoyment in learning mathematics. They disagreed (2≤M<3) that *Reading a textbook, Individual work* and *Individual help* promoted enjoyment. These differences were statistically significant. Importantly, no teaching method overall was agreed or strongly agreed to promote enjoyment, although there was a wide distribution of responses.

Table 4.1.13: Mean scores and Standard Deviation; enjoyment; perceptions of 5th graders

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	1479	1476	1475	1478	1479	1472	1479	1479
M	3.29	3.31	2.84	3.43	2.92	2.44	3.16	3.12
SD	1.33	1.56	1.18	1.23	1.32	1.23	1.21	1.23

The result of a repeated measure ANOVA [F (8,11712)=86.48, p<. 01]

Figure 4.1.11: Enjoyment promoted by different teaching methods; perceptions of 5th graders



Motivation

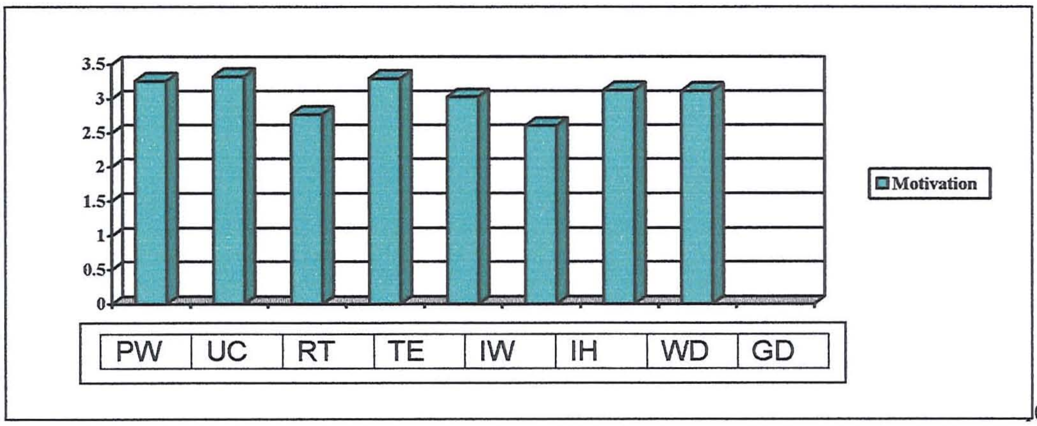
When motivation was considered, a similar pattern emerged (see Table 4.1.14 and Figure 4.1.12). 5th graders expressed neither agreement nor disagreement (3≤M<4) that *Practical work, Using a computer, Teacher explanation, Individual work, Whole-class discussion,* and *Group discussion* promoted their motivation. They disagreed (2≤M<3) that *Reading a textbook* and *Individual help* promoted motivation. These differences were statistically significant. Overall, no teaching method was agreed or strongly agreed to promote motivation. In all cases there was a wide distribution of scores (1.0<SD).

Table 4.1.14: Mean scores and Standard Deviation; motivation; perceptions of 5th graders

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	1479	1476	1476	1479	1479	1477	1479	1479
M	3.26	3.33	2.77	3.30	3.03	2.61	3.13	3.12
SD	1.34	1.50	1.28	1.27	1.40	1.34	1.24	1.24

The result of a repeated measure ANOVA [$F(8,11760)=58.58$, $p<.01$]

Figure 4.1.12: Motivation promoted by different teaching methods; perceptions of 5th graders



A sense of security

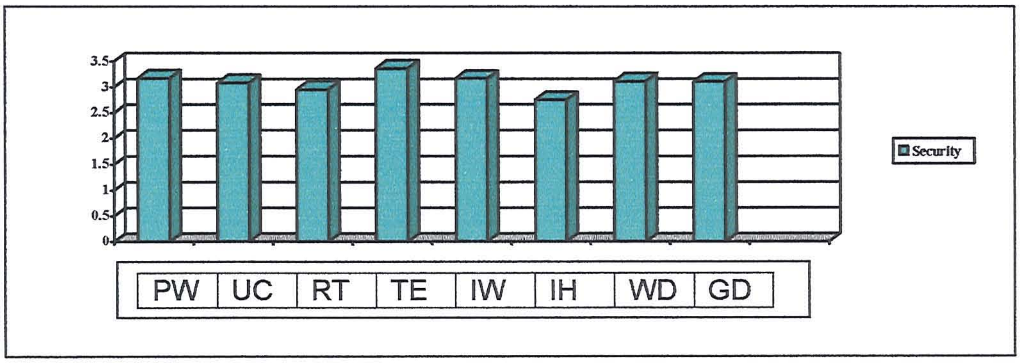
In relation to sense of security, 5th graders neither agreed nor disagreed ($3 \le M < 4$) that *Practical work, Using a computer, Teacher explanation, Individual work, Whole-class discussion* and *Group discussion* promoted their sense of security. They disagreed ($2 \le M < 3$) that *Reading a textbook* and *Individual help* promoted it. These findings were statistically significant. Overall, no teaching method was agreed or strongly agreed to promote a sense of security, but there was a relatively large distribution of responses ($1.0 < SD$) across statements (see Table 4.1.15 and Figure 4.1.13).

Table 4.1.15: Mean scores and Standard Deviation; a sense of security; perceptions of 5th graders

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	1473	1472	1471	1473	1474	1473	1474	1474
M	3.18	3.09	2.96	3.37	3.17	2.75	3.12	3.11
SD	1.30	1.46	1.32	1.27	1.39	1.37	1.26	1.23

The result of a repeated measure ANOVA [F (8,11712)=38.06, p<. 01]

Figure 4.1.13: Sense of security promoted by different teaching methods; perceptions of 5th graders



A sense of progress

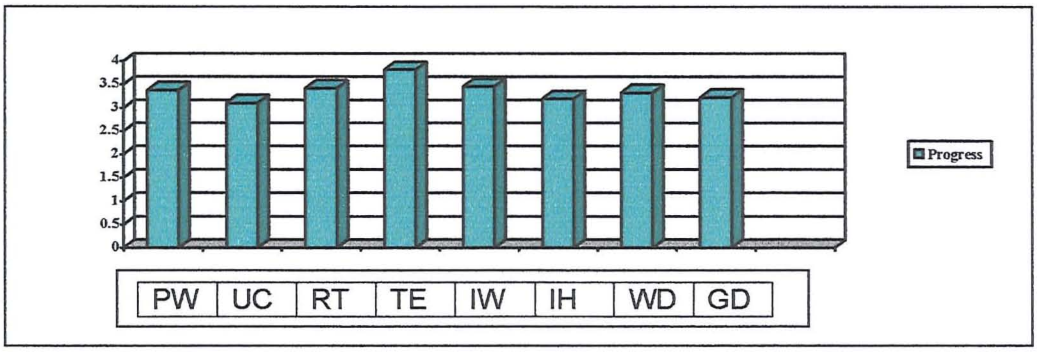
Table 4.1.16 and Figure 4.1.14 below show that 5th graders expressed neither agreement nor disagreement ($3 \le M < 4$) that any of the teaching methods taken up in this study promoted their sense of progress in learning mathematics. Overall, no teaching method was agreed or strongly agreed to promote a sense of progress in learning mathematics. However, there was a wide distribution of responses ($1.0 < SD$).

Table 4.1.16: Mean scores and Standard Deviation; a sense of progress; perceptions of 5th graders

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	1474	1469	1473	1476	1476	1475	1476	1474
M	3.38	3.11	3.42	3.82	3.46	3.20	3.33	3.23
SD	1.31	1.37	1.34	1.20	1.34	1.39	1.28	1.23

The result of a repeated measure ANOVA [$F(8,11680)=70.79$, $p<.01$]

Figure 4.1.14: Sense of progress promoted by different teaching methods; perceptions of 5th graders



Deployment

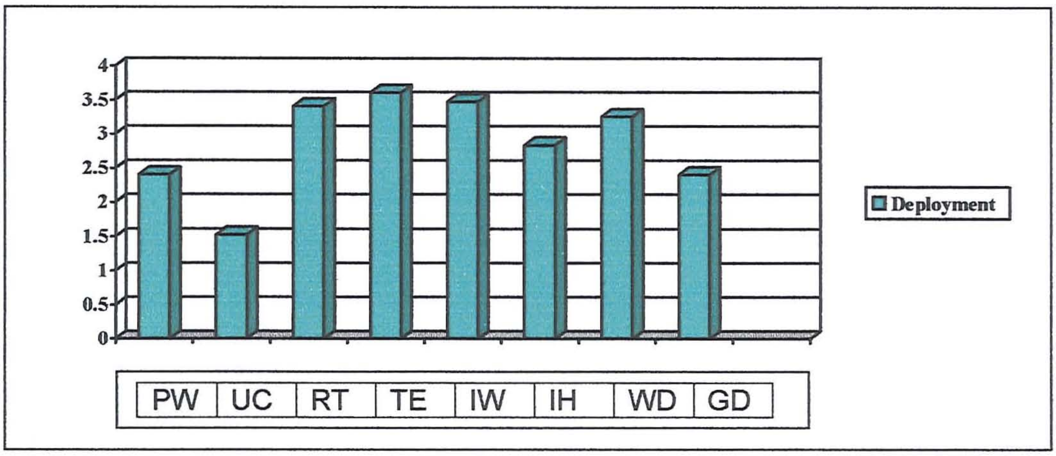
5th graders reported that *Reading a textbook, Teacher explanation, Individual work,* and *Whole-class discussion* were sometimes ($3 \leq M < 4$) deployed in their mathematics classes, while *Practical work, Individual help* and *Group discussion* were hardly ever ($2 \leq M < 3$) deployed. *Using a computer* was reported as never ($1 \leq M < 2$) being deployed in their mathematics classes. The results of a repeated measure showed that these differences were statistically significant. There were relatively large distributions ($1.0 < SD$) in the perceived frequency of deployment of *Teacher explanation, Individual work, Individual help* and *Whole-class discussion. Teacher explanation* and *Individual work* were seen by 5th graders as being frequently deployed, although *Individual help* was perceived as being less frequently deployed, compared to *Teacher explanation* and *Individual work* (see Table 4.1.17 and Figure 4.1.15).

Table 4.1.17: Mean scores and Standard Deviation; deployment; perceptions of 5th graders

	Practical Work (PW)	Using a Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	1476	1473	1473	1467	1467	1472	1459	1463
M	2.41	1.53	3.41	3.61	3.48	2.84	3.26	2.41
SD	.92	.80	.97	1.05	1.00	1.03	1.10	.92

The result of a repeated measure ANOVA [$F(8,11352)=1017.32$, $p<.01$]

Figure 4.1.15: Deployment of different teaching methods in mathematics classes; perceptions of 5th graders



Summary

Table 4.1.18: Summary of the perceptions of 5th graders

	Enjoyment	Motivation	A sense of security	A sense of progress	Deployment
M=5					
4≤M<5					
3≤M<4	Practical work Using a computer Teacher explanation Whole-class discussion Group discussion	Practical work Using a computer Teacher explanation Individual work Whole-class discussion Group discussion	Practical work Using a computer Teacher explanation Individual work Whole-class discussion Group discussion	Practical work Using a computer Reading a textbook Teacher explanation Individual work Individual help Whole-class discussion Group discussion	Reading a textbook Teacher explanation Individual work Whole-class discussion
2≤M<3	Reading a textbook Individual work Individual help	Reading a textbook Individual help	Reading a textbook Individual help		Practical work Individual help Group discussion
1≤M<2					Using a computer

Table 4.1.18 summarises the data. 5th graders perceived that the different teaching methods deployed in mathematics classes promoted their affective attitudes towards

mathematics learning differently, and that the different teaching methods were deployed for different amounts of time. No teaching method was agreed or strongly agreed to promote positive affective attitudes. No teaching method was perceived as always or nearly always being deployed in classes.

In comparison with their teachers, pupils perceived that *Teacher explanation*, *Individual work* and *Individual help* were deployed less. *Teacher explanation,* which was perceived as frequently deployed in mathematics classes at 5th grade, appeared to have the least negative effect on attitudes towards mathematics learning. *Individual work,* also frequently deployed, was perceived as negative for promoting enjoyment, and neutral in relation to other aspects. 5th graders overall did not perceive that *Individual help* was frequently adopted in their classrooms, in contrast with their teachers reporting that they adopted this method frequently. The pupils perceived this method as neutral in promoting a sense of progress but negative in promoting other aspects of positive affect. Overall, 5th graders did not seem to prefer individualised teaching methods.

Reading a textbook, which was also perceived as being frequently deployed, was perceived overall as negative in promoting positive attitudes, while *Practical work* was perceived as relatively positive, although it was not often deployed. *Whole-class discussion* was sometimes deployed and more frequently than *Group discussion*; this was compatible with the teachers' perceptions. These teaching methods were perceived as neutral in promoting positive attitudes. *Using a computer* was reported as never being deployed, although it was perceived as being neutral in promoting positive attitudes.

A wide distribution (1.0<SD) existed in the extent to which affective attitudes were seen to be promoted by different teaching methods. This suggests that there may be wide individual differences in pupils' preferences for different kinds of teaching methods, although there were some pupils who gave either all high or all low responses to all teaching methods. As a wide distribution existed in responses regarding the frequency of the deployment of *Whole-class discussion* among the perceptions of both teachers and pupils, this teaching method may be deployed to a different extent amongst teachers. The distribution in teachers' perceived frequency of deployment of *Teacher explanation, Individual work* and *Individual help* was relatively small. There was variability in pupils' perceptions even when overall perceptions of deployment among teachers was similar.

This was especially the case for *Teacher explanation* and *Individual work*, and may be because with these methods, pupils are given the same amount of time to perform tasks but actually perform them at different individual speeds. Teachers may give individual help to a different extent for each pupil in a class.

4.1.4: Descriptive statistics of the responses of 8th graders

Enjoyment

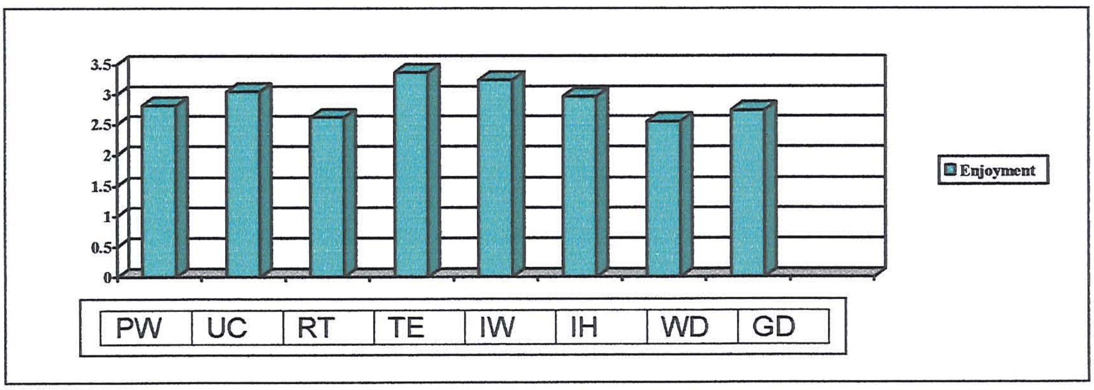
Table 4.1.19 and Figure 4.1.16 below show that 8th graders expressed neither agreement nor disagreement ($3 \leq M < 4$) that *Using a computer, Teacher explanation,* and *Individual work* promoted their enjoyment in learning mathematics. They disagreed ($2 \leq M < 3$) that *Practical work, Reading a textbook, Individual help, Whole-class discussion* and *Group discussion* promoted enjoyment. These differences were statistically significant. A relatively wide distribution existed in the extent to which enjoyment was perceived to be promoted by the different teaching methods. While 8th graders did not feel that any teaching method actually promoted enjoyment, those which were the least negative were reported as frequently being deployed by the teachers: *Teacher explanation*, *Individual work* and *Individual help*.

Table 4.1.19: Mean scores and Standard Deviation; enjoyment, perceptions of 8th graders

	Practical Work (PW)	Using Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	2156	2155	2154	2156	2156	2156	2156	2156
M	2.82	3.05	2.62	3.37	3.24	2.97	2.55	2.74
SD	1.36	1.52	1.19	1.24	1.26	1.32	1.22	1.31

The result of a repeated measure ANOVA [$F(8, 17208)=113.55$, $p<.01$]

Figure 4.1.16: Enjoyment promoted by different teaching methods; perceptions of 8th graders



Motivation

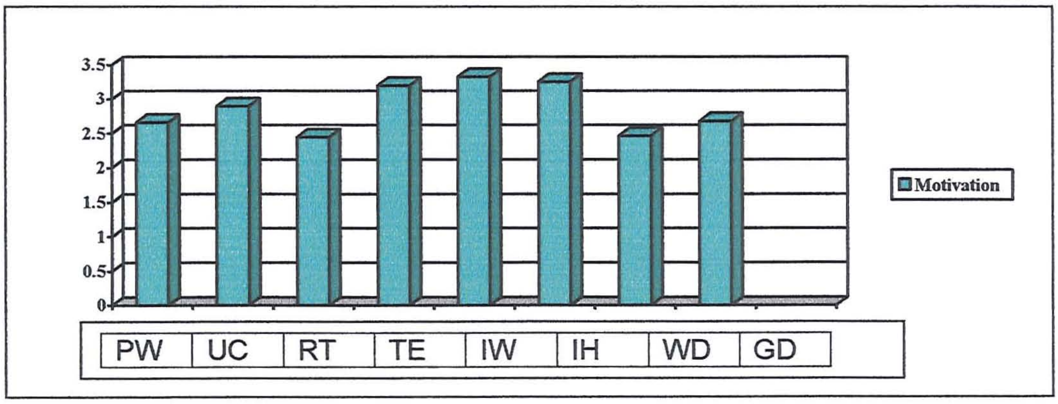
In relation to motivation, Table 4.1.20 and Figure 4.1.17 below show that 8th graders neither agreed nor disagreed (3≤M<4) that *Teacher explanation, Individual work,* and *Individual help* promoted their motivation. They disagreed (2≤M<3) that *Practical work, Using a computer, Reading a textbook, Whole-class discussion* and *Group discussion* promoted motivation. These findings were statistically significant. A relatively wide distribution existed in the extent to which their motivation to learn mathematics was perceived to be promoted by different teaching methods. While 8th graders did not feel that any teaching method actually promoted motivation, those, which were perceived as the least negative were the ones reported as most frequently deployed by the teachers of 8th graders: *Teacher explanation*, *Individual work* and *Individual help*.

Table 4.1.20: Mean scores and Standard Deviation; motivation; perceptions of 8th graders

	Practical Work (PW)	Using Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	2149	2147	2142	2148	2148	2149	2149	2148
M	2.66	2.90	2.45	3.20	3.33	3.26	2.47	2.68
SD	1.29	1.39	1.17	1.22	1.29	1.35	1.19	1.28

The result of a repeated measure ANOVA [F (8, 17096)=197.43, p<. 01]

Figure 4.1.17: Motivation promoted by different teaching methods; perceptions of 8th graders



A sense of security

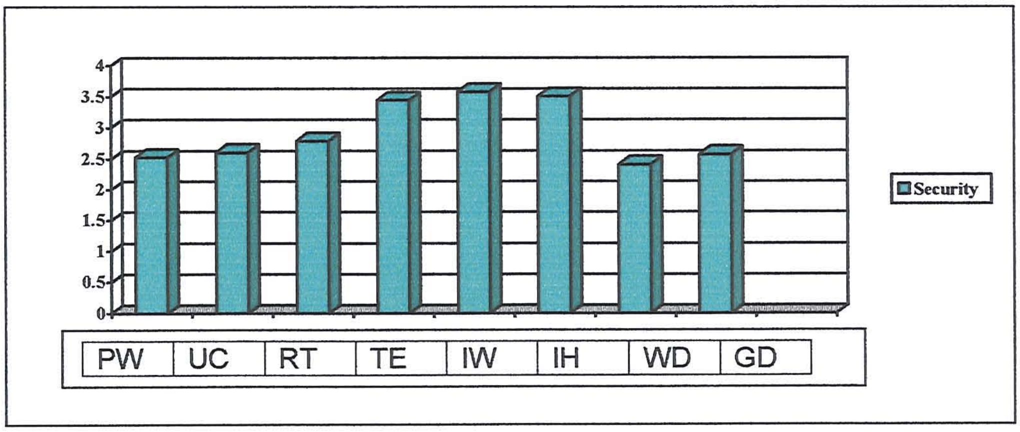
Table 4.1.21 and Figure 4.1.18 below show that 8th graders expressed neither agreement nor disagreement (3≤M<4) that *Teacher explanation, Individual work* and *Individual help* promoted their sense of security. They expressed disagreement (2≤M<3) that *Practical work*, *Using a computer*, *Reading a textbook, Whole-class discussion* and *Group discussion* promoted it. A relatively wide distribution existed in the extent to which sense of security was perceived to be promoted by all of the teaching methods considered here. While 8th graders did not feel that any teaching method positively promoted a sense of security, those which were perceived as the least negative were the teaching methods reported as frequently being deployed by the teachers of 8th graders, *Teacher explanation*, *Individual work* and *Individual help*.

Table 4.1.21: Mean scores and Standard Deviation; a sense of security; perceptions of 8th graders

	Practical Work (PW)	Using Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	2141	2138	2141	2141	2141	2140	2140	2138
M	2.53	2.61	2.79	3.44	3.58	3.51	2.41	2.58
SD	1.20	1.28	1.24	1.23	1.27	1.33	1.14	1.20

The result of a repeated measure ANOVA [F (8,17064)=448.59, p<. 01]

Figure 4.1.18: Sense of security promoted by different teaching methods; perceptions of 8th graders



A sense of progress

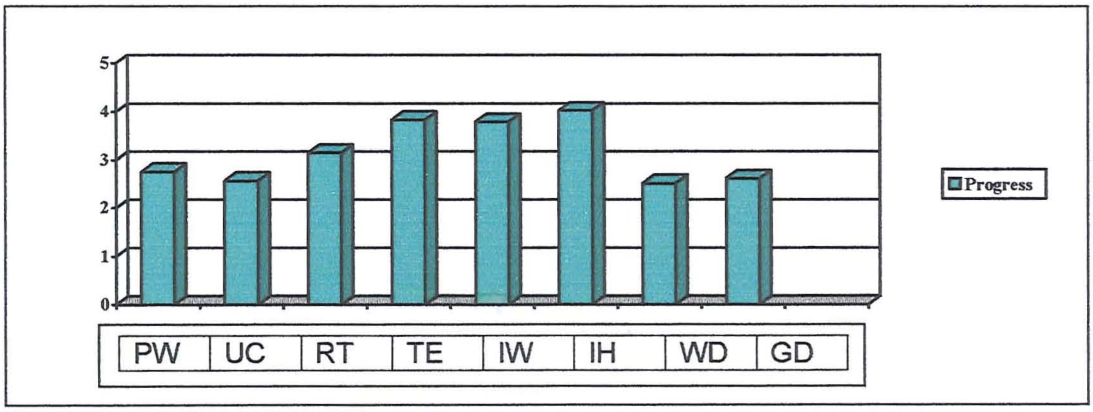
Table 4.1.22 and Figure 4.1.19 below show that 8th graders believed strongly (4≤M<5) that *Individual help* promoted their sense of progress. They neither agreed nor disagreed (3≤M<4) that *Reading a textbook, Teacher explanation,* and *Individual work* promoted it, and they expressed disagreement (2≤M<3) that *Practical work, Using a computer, Whole-class discussion* and *Group discussion* promoted it. These differences were statistically significant. A relatively wide distribution of responses existed in the extent to which sense of progress was perceived to be promoted by all of the teaching methods considered. 8th graders felt that only *Individual help* positively promoted a sense of progress. This was one of the teaching methods reported as frequently being deployed by the teachers of 8th graders.

Table 4.1.22: Mean scores and Standard Deviation; a sense of progress, perceptions of 8th graders

	Practical Work (PW)	Using Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	2143	2138	2141	2142	2143	2142	2143	2142
M	2.75	2.57	3.15	3.83	3.79	4.03	2.52	2.62
SD	1.26	1.22	1.26	1.10	1.16	1.15	1.15	1.19

The result of a repeated measure ANOVA [F(8,17064)=800.79, p<.01]

Figure 4.1.19: Sense of progress promoted by different teaching methods, perceptions of 8th graders



Deployment

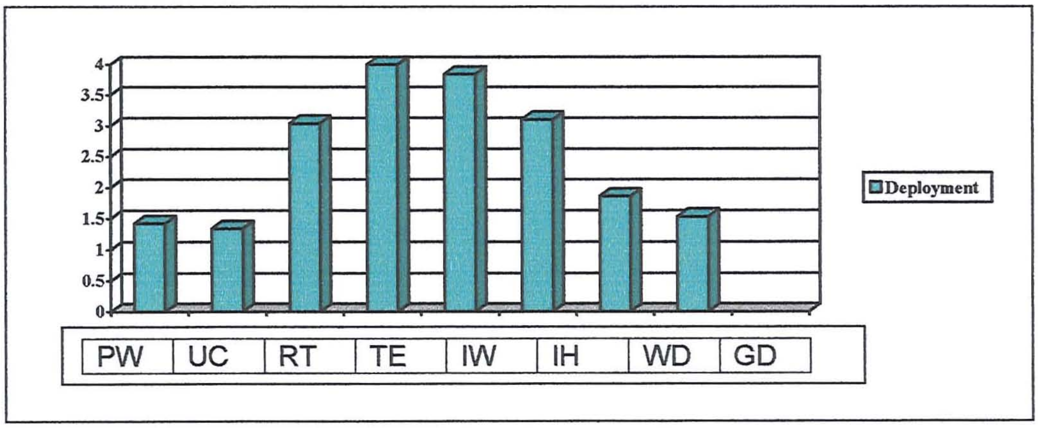
Table 4.1.23 and Figure 4.1.20 below show that 8[th] graders reported that *Teacher explanation* was always (M=4) deployed in their mathematics classes; and that *Reading a textbook, Individual work,* and *Individual help* were sometimes (3≤M<4) deployed. There was a similarity between the perceptions of the teachers and the perceptions of their pupils in that *Teacher explanation*, *Individual work*, *Individual help* and *Reading a textbook* were perceived to be frequently deployed in mathematics classes at 8[th] grade. *Practical work, Using a computer, Whole-class discussion* and *Group discussion* were reported as never (1≤M<2) being deployed. The results of a repeated measure ANOVA indicated that these findings were statistically significant. A relatively wide distribution existed in the frequency of the perceived deployment of *Reading a textbook, Teacher explanation* and *Individual help.*

Table 4.1.23: Mean scores and Standard Deviation; deployment; perceptions of 8[th] graders

	Practical Work (PW)	Using Computer (UC)	Reading a Textbook (RT)	Teacher Explanation (TE)	Individual Work (IW)	Individual Help (IH)	Whole-class Discussion (WD)	Group Discussion (GD)
N	2142	2144	2135	2134	2134	2134	2128	2124
M	1.42	1.34	3.04	4.00	3.84	3.10	1.86	1.53
SD	.61	.67	1.15	1.01	.90	1.09	.94	.77

The result of a repeated measure ANOVA [$F(8,16416)=3781.66$, $p<.01$]

Figure 4.1.20: Deployment of different teaching methods in mathematics classes; perceptions of 8[th] graders



Summary

Table 4.1.24: Summary of the perceptions of 8th graders

	Enjoyment	Motivation	A sense of security	A sense of progress	Deployment
M=5					
4≤M<5				Individual help	Teacher explanation
3≤M<4	Using a computer Teacher explanation Individual work	Teacher explanation Individual work Individual help	Teacher explanation Individual work Individual help	Reading a textbook Teacher explanation Individual work	Reading a textbook Individual work Individual help
2≤M<3	Practical work Reading a textbook Individual help Whole-class discussion Group discussion	Practical work Using a computer Reading a textbook Whole-class discussion Group discussion	Practical work Using a computer Reading a textbook Whole-class discussion Group discussion	Practical work Using a computer Whole-class discussion Group discussion	
1≤M<2					Practical work Using a computer Whole-class discussion Group discussion

Table 4.1.24 summarises the data from this section. 8th graders perceived that the different teaching methods deployed in mathematics classes promoted their positive affective attitudes towards mathematics learning differently. They did not feel that any teaching method positively promoted affective attitudes, except that *Individual help* was perceived to promote a sense of progress. The teaching methods which were the least negative were those reported as frequently being deployed at 8th grade: *Teacher explanation*, *Individual work*, and *Individual help.* Both teachers and pupils reported that *Reading a textbook* was relatively frequently deployed in mathematics classes. Both teachers and pupils appeared to perceive that this teaching method acted negatively to promote enjoyment and motivation.

8th graders perceived that the teaching methods deployed in their mathematics classes were likely to be limited to the four methods mentioned above. *Practical work*, *Using a computer*, *Whole-class discussion* and *Group discussion* were not deployed. These four teaching methods were perceived as negative in promoting positive attitudes towards mathematics learning, except that *Using a computer* was perceived as neutral.

There was a relatively wide distribution of responses (1.0<SD) in the extent to which positive affective attitudes towards mathematics learning were perceived to be promoted by different teaching methods. A similar tendency was found among the perceptions of

5th graders. Also a relatively wide distribution existed in the perceived frequency of the deployment of *Reading a textbook, Teacher explanation* and *Individual help.* A large distribution with respect to *Teacher explanation* and *Individual help* was found at both age groups. As a wide distribution also existed with respect to *Reading a textbook* among the perceptions of the teachers, this teaching method may be deployed to a different extent amongst teachers. There was a wider distribution for pupils on *Teacher explanation* and *Individual help* in contrast to a relatively small distribution for teachers at both age groups.

4.1.5: Overall Summary of 4.1

Both teachers and pupils perceived that the different teaching methods deployed in mathematics classes promoted pupils' positive affective attitudes towards mathematics learning differently. They also perceived differences in the frequency of the deployment of the methods.

Teachers of both age groups were likely to adopt teaching methods that they believed promoted pupils' sense of security and sense of progress rather than enjoyment and motivation, i.e. *Individual work* and *Individual help.* Teachers of both age groups appeared to use *Teacher explanation* and *Reading a textbook*, even though they perceived that these methods were at best neutral in promoting pupils' positive attitudes. Wide variation existed in the reported deployment of these teaching methods and the teachers' perceptions of the extent to which they enhanced pupils' sense of security. Teachers of both age groups did not appear to adopt teaching methods which they believed were less beneficial for promoting pupils' sense of progress and sense of security, even if they believed that these teaching methods promoted pupils' enjoyment and motivation. *Practical work* fits this category. *Whole-class discussion* was relatively frequently deployed at 5th grade, but a wide distribution exists in the responses. The deployment of *Group discussion* was much less than *Whole-class discussion.* Computers were rarely used and responses regarding the promotion of enjoyment and motivation through using computers varied.

Pupils of both age groups reported no teaching method as always being deployed, although 8th graders reported that *Teacher explanation* was nearly always deployed.

Teacher explanation, *Individual work* and *Reading a textbook* were perceived as most frequently deployed at both grades. 8th graders perceived that *Individual help* was also frequently deployed, while 5th graders overall did not perceive that this teaching method was adopted frequently. 5th graders' perceived frequency of *Individual help* was much less than that of their teachers.

For 8th graders the teaching methods frequently deployed were relatively closely matched with pupils' preferences as inferred from their responses regarding affective attitudes. However, some incompatibility appeared to exist between the frequency of the deployment of teaching methods and pupils' preferred teaching methods at 5th grade. For 8th graders, *Teacher explanation*, *Individual work,* and *Individual help,* which were perceived as deployed most frequently, were perceived to have the least negative effect on affective attitudes towards mathematics learning. For 5th graders, *Teacher explanation* appeared to be the least negative but they perceived that *Individual help* negatively affected all attitudes and that *Individual work* negatively promoted enjoyment.

Teachers and pupils of both age groups reported that *Reading a textbook* was relatively frequently deployed. It was not perceived by teachers or pupils as enhancing enjoyment or motivation. The low frequency of the deployment of *Practical work, Group discussion* and *Using a computer* does not necessarily indicate that either teachers or pupils perceived that these teaching methods have a negative effect on pupils' attitudes at 5th grade. In fact both teachers and pupils perceived that *Practical work* could have a positive effect. Both teachers and pupils of 8th graders reported that *Practical work, Using a computer, Whole-class discussion* and *Group discussion* were hardly ever or never deployed. The teachers perceived that these teaching methods were at least neutral in promoting positive attitudes whereas the pupils perceived them as having a negative effect.

Some teaching methods had very wide distributions in their reported frequency of deployment, among the responses of both teachers and pupils in particular: *Whole-class discussion* at 5th grade and *Reading a textbook* at 8th grade. This suggests that the frequency of adopting these methods varies from one teacher to another. Some teaching methods had a wide distribution in their reported frequency of deployment in only the pupils' responses. *Teacher explanation* and *Individual help* at both grades, and

Individual work at 5th grade fit this category. This suggests that pupils vary in their perceptions of the frequency of deployment of *Teacher explanation* and *individual work* where individuals' own speed of working will affect how much they can achieve in the amount of time allowed by the teacher. This may determine the extent to which they feel they are involved in mathematics learning. Some teaching methods have a wide distribution in the reported frequency of deployment in only the teachers' responses. *Reading a textbook* at 5th grade and discussion-style teaching methods at 8th grade fit this category.

There was a wide distribution in many of the responses from the pupils in the extent to which individual teaching methods were perceived to promote positive affective attitudes, which suggests that their responses were strongly affected by personal preferences.

To conclude, the range of teaching methods adopted was relatively narrow as reported by both pupils and teachers, and became increasingly so as pupils moved to 8th grade. Few of the methods adopted were perceived by either pupils or teachers to promote positive attitudes towards learning mathematics.

4.2: Comparison of pupils and teachers' perceptions of the extent to which the four aspects of attitudes towards learning are promoted by different teaching methods

The results of the data analysis in the previous section suggested that both teachers and pupils thought that the teaching methods did not promote all of the four aspects equally. Teachers of both age groups thought that *Individual work* and *Individual help* promoted pupils' sense of security and sense of progress rather than enjoyment and motivation. On the other hand, they thought that *Practical work* was less beneficial for pupils' sense of security and sense of progress compared to its positive effects on enjoyment and motivation. Pupils of both age groups thought that *Individual help* and *Reading a textbook* were not enjoyable despite their benefits in promoting their sense of progress. However, the findings reported in the previous section did not compare these differences statistically, because the section aimed to compare the participants' perceptions of pupils' attitudes toward learning mathematics between teaching methods. In this section each teaching method is compared statistically to see the extent to which teachers and pupils agree on its effects.

Practical work

The results of repeated measure ANOVAs indicated that the members of each group perceived that *Practical work* promoted the four aspects differently (see Figure 4.2.1 and Table 4.2.1). Teachers of both age groups perceived that *Practical work* promoted pupils' enjoyment and motivation more than their sense of security and sense of progress, although the differences were small. Their pupils perceived that this teaching method promoted sense of progress equally or more than other aspects. Teachers and pupils of both age groups perceived that the frequency of deployment of *Practical work* was low. In all cases teachers were more optimistic about the positive effects than pupils. In addition, teachers and pupils of 5th graders were more positive than 8th graders.

Figure 4.2.1: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Practical work*

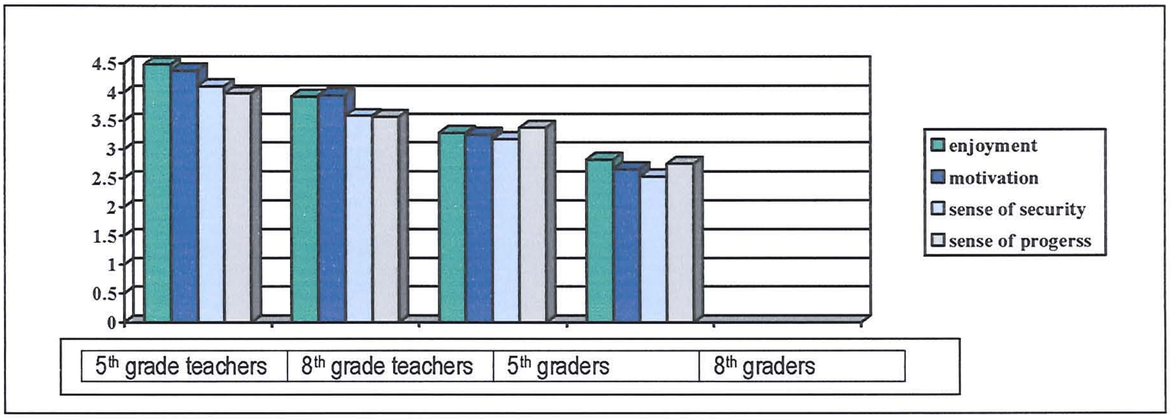


Table 4.2.1: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Practical work*

	5th grade teachers			8th grade teachers			5th graders			8th graders		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Enjoyment	48	4.48	.58	42	3.93	1.05	1479	3.29	1.33	2156	2.82	1.36
Motivation	48	4.38	.79	42	3.95	.76	1479	3.26	1.34	2149	2.66	1.29
Sense of security	47	4.11	.67	39	3.59	.82	1473	3.18	1.30	2141	2.53	1.20
Sense of progress	48	3.98	.73	42	3.57	.83	1474	3.38	1.31	2143	2.75	1.26
Repeated measure ANOVA	$F(2.401,110.455)=8.037$, $p<.01$			$F(2.340, 88.934)=4.145$ $p<.05$			$F(2.819, 4135.601)=13.379$, $p<.01$			$F(2.750, 5861.134)=51.600$ $p<.01$		
Deployment	48	2.96	.77	42	2.12	.86	1476	2.41	.92	2142	1.42	.61

Using a computer

Figure 4.2.2 and Table 4.2.2 below indicate that both teachers and pupils perceived that *Using a computer* promoted pupils' enjoyment and motivation more than their sense of security and sense of progress. Teachers and pupils of both age groups reported that on average computers were never used in mathematics classes so their assessment of the effect on attitudes to learning mathematics were not likely to be based on their experiences in school.

Figure 4.2.2: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Using a computer*

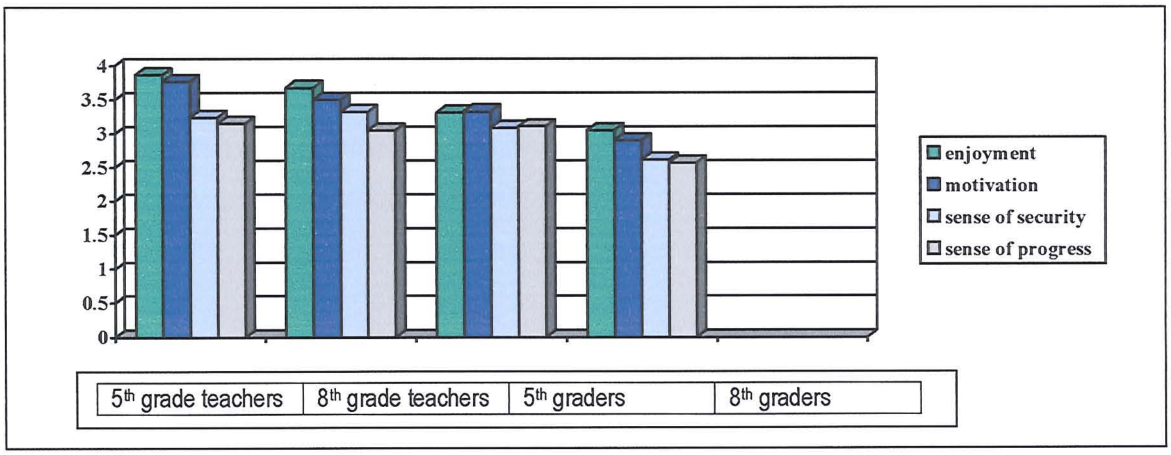


Table 4.2.2: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Using a computer*

	5th grade teachers			8th grade teachers			5th graders			8th graders		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Enjoyment	47	3.87	.90	40	3.68	1.00	1476	3.31	1.56	2155	3.05	1.52
Motivation	48	3.77	1.04	40	3.50	.78	1476	3.33	1.50	2147	2.90	1.39
Sense of security	46	3.24	.85	38	3.32	.66	1472	3.09	1.46	2138	2.61	1.28
Sense of progress	47	3.15	.72	40	3.05	.81	1469	3.11	1.37	2138	2.57	1.22
Repeated measure ANOVA	$F(2.605, 114.599)=13.001$, $p<.01$			$F(2.011, 74.404)=6.629$, $p<.01$			$F(2.704, 3950.298)=31.317$, $p<.01$			$F(2.609, 5541.027)=157.138$, $p<.01$		
Deployment	48	1.77	.78	42	1.48	.74	1473	1.53	.80	2144	1.34	.67

Reading a textbook

In contrast to *Practical work* and *Using a computer, Reading a textbook* was seen to promote a sense of security and sense of progress (see Figure 4.2.3 and Table 4.2.3). There was also less difference between the responses of teachers and students. Although *Reading a textbook* was relatively frequently adopted in mathematics classes, overall *Reading a textbook* was not viewed very positively by any of the participants.

Figure 4.2.3: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Reading a textbook*

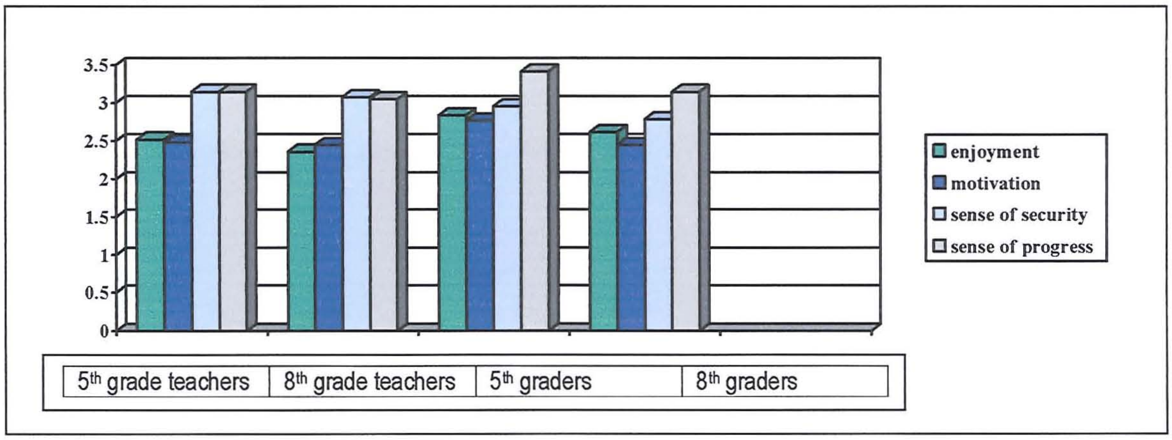


Table 4.2.3: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Reading a textbook*

	5th grade teachers			8th grade teachers			5th graders			8th graders		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Enjoyment	48	2.52	.87	42	2.36	.93	1475	2.84	1.18	2154	2.62	1.19
Motivation	48	2.48	.95	42	2.45	.94	1476	2.77	1.28	2142	2.45	1.17
Sense of security	47	3.15	.93	40	3.08	1.00	1471	2.96	1.32	2141	2.79	1.24
Sense of progress	48	3.15	.85	42	3.05	.94	1473	3.42	1.34	2141	3.15	1.26
Repeated measure ANOVA	$F(2.385, 109.716)=26.140$, $p<.01$			$F(2.441, 95.183)=16.461$, $p<.01$			$F(2.827, 4136.341)=159.355$ $p<.01$			$F(2.800, 5938.988)=295.240$ $p<.01$		
Deployment	48	3.50	1.11	42	3.12	1.27	1473	3.41	.97	2136	3.04	1.15

Teacher explanation

Figure 4.2.4 and Table 4.2.4 below indicate that teachers and pupils of both age groups perceived that *Teacher explanation* promoted pupils' sense of progress more than enjoyment, motivation and sense of security. The deployment of *Teacher explanation* was relatively high in mathematics classes. Nonetheless, it was only in relation to sense of progress that, overall, teachers and pupils agreed that it was positive in its effect.

Figure 4.2.4: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Teacher explanation*

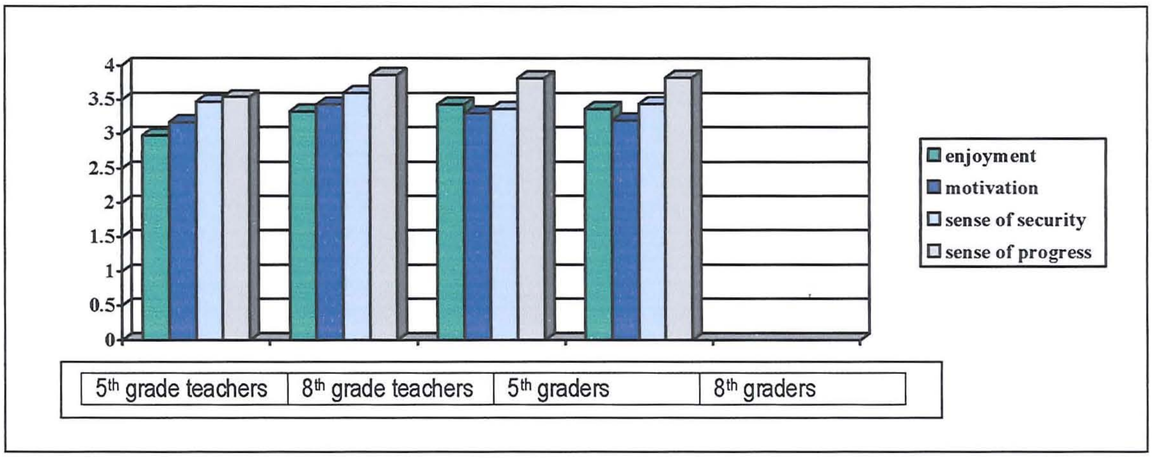


Table 4.2.4: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Teacher explanation*

	5th grade teachers			8th grade teachers			5th graders			8th graders		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Enjoyment	48	2.98	.79	42	3.33	.79	1478	3.43	1.23	2156	3.37	1.24
Motivation	47	3.17	.89	42	3.43	.74	1479	3.30	1.27	2148	3.20	1.22
Sense of security	47	3.47	1.02	40	3.60	.78	1473	3.37	1.27	2141	3.44	1.23
Sense of progress	48	3.54	.77	42	3.86	.72	1476	3.82	1.20	2142	3.83	1.10
Repeated measure ANOVA	$F(3,135)=6.945$, $p<.01$			$F(3,117)=7.030$, $p<.01$			$F(2.960,4345.052)=124.965$ $p<.01$			$F(2.901,6176.865)=239.998$ $p<.01$		
Deployment	48	4.48	.65	42	4.50	.67	1467	3.61	1.05	2134	4.00	1.01

Individual work

As with *Teacher explanation*, *Individual work* was seen by teachers to be most positive in relation to sense of progress and sense of security. Pupils, particularly at 5th grade, were less positive (see Figure 4.2.5 and Table 4.2.5). There was a shared perception that *Individual work* constituted a fairly high proportion of mathematics lessons.

Figure 4.2.5: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Individual work*

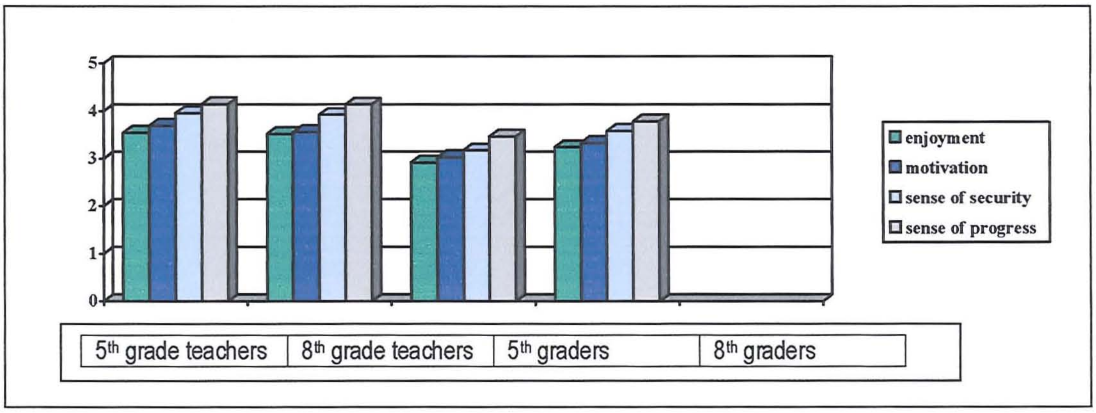


Table 4.2.5: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Individual work*

	5th grade teachers			8th grade teachers			5th graders			8th graders		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Enjoyment	48	3.54	.74	42	3.52	.71	1479	2.92	1.32	2156	3.24	1.26
Motivation	48	3.69	.75	42	3.55	.63	1479	3.03	1.40	2148	3.33	1.29
Sense of security	47	3.96	.72	40	3.93	.76	1474	3.17	1.39	2141	3.58	1.27
Sense of progress	48	4.15	.68	42	4.14	.78	1476	3.46	1.34	2143	3.79	1.16
Repeated measure ANOVA	$F(2.281, 104.948)=11.339$ $p<.01$			$F(2.520, 98.270)=10.078$, $p<.01$			$F(2.929, 4305.291)=93.754$ $p<.01$			$F(2.853, 6077.845)$, $p<.01$		
Deployment	48	4.50	.65	42	4.17	.73	1467	3.48	1.00	2134	3.84	.90

Individual help

There was a marked contrast between pupils' and teachers' responses. Teachers believed that this promoted senses of security and progress much more than their pupils, particularly the 5th graders. The effect was not so strong in relation to 8th graders. Teachers of both age groups reported that the frequency of deployment of *Individual help* was high. However, 8th graders reported the frequency moderate, and 5th graders reported it as relatively low. This may explain why they perceived that it was not strong in its effect on their attitudes to learning.

Figure 4.2.6: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Individual help*

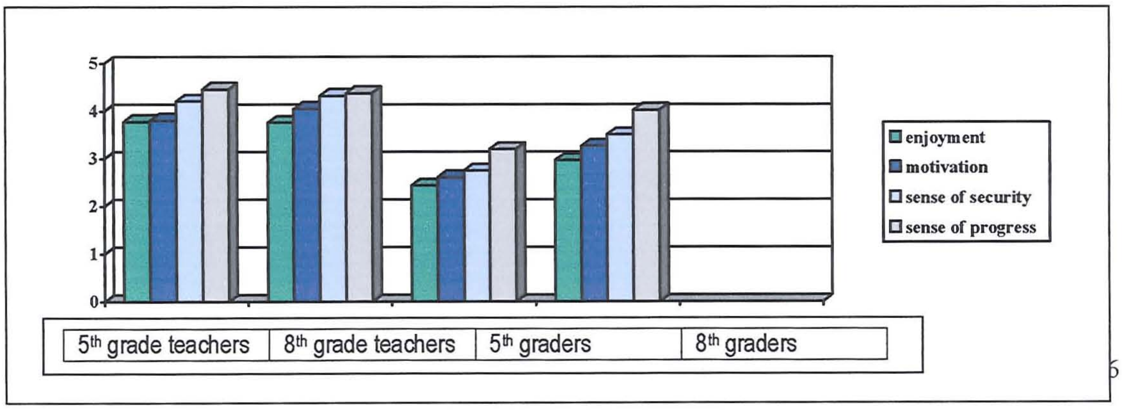


Table 4.2.6: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Individual help*

	5th grade teachers			8th grade teachers			5th graders			8th graders		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Enjoyment	48	3.79	.85	42	3.76	.82	1472	2.44	1.23	2156	2.97	1.32
Motivation	48	3.81	.94	42	4.05	.73	1477	2.61	1.34	2149	3.26	1.35
Sense of security	47	4.21	.81	40	4.33	.73	1473	2.75	1.37	2140	3.51	1.33
Sense of progress	48	4.46	.77	42	4.38	.62	1475	3.20	1.39	2142	4.03	1.15
Repeated measure ANOVA	$F(3,138)=18.581$, $p<.01$			$F(3,117)=10.920$, $p<.01$			$F(2.756,4029,844)=192.747$ $p<.01$			$F(2.824,6012.850)=573.563$ $p<.01$		
Deployment	48	4.33	.63	42	4.00	.86	1472	2.84	1.03	2134	3.10	1.09

Whole-class discussion

The pattern for *Whole-class discussion* was similar across all the attitudinal aspects for teachers of both age groups, although 5th grade teachers perceived that this teaching method promoted sense of security less positively than other aspects. Pupils of both age groups perceived that *Whole-class discussion* promoted sense of progress more than other aspects, although no average score was greater than 4 indicating only moderate agreement (See Figure 4.2.7 and Table 4.2.7). *Whole-class discussion* was perceived as being deployed with at least moderate frequency at 5th grade, but lower at 8th grade. At both grade levels teachers perceived greater frequencies than their pupils.

Figure 4.2.7: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Whole-class discussion*

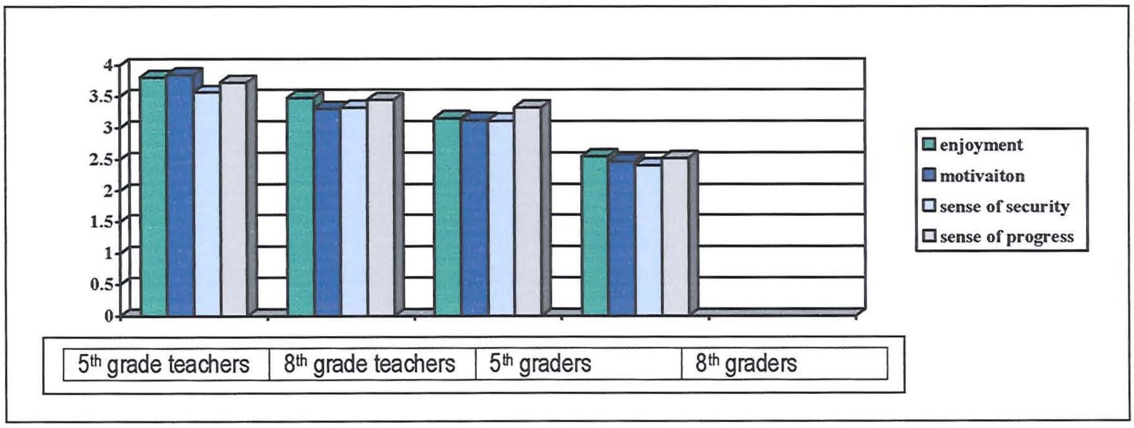


Table 4.2.7: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Whole-class discussion*

	5th grade teachers			8th grade teachers			5th graders			8th graders		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Enjoyment	48	3.81	.82	42	3.48	.71	1479	3.16	1.21	2156	2.55	1.22
Motivation	48	3.85	.87	42	3.31	.84	1479	3.13	1.24	2149	2.47	1.19
Sense of security	47	3.57	.71	40	3.33	.73	1474	3.12	1.26	2140	2.41	1.14
Sense of progress	48	3.73	.76	42	3.45	.74	1476	3.33	1.28	2143	2.52	1.15
Repeated measure ANOVA	F(2.527, 116.246)=3.109, p<.05			F(2.484, 96.892)=.868, p>.05			F(2.884, 4239.621)=19.525, p<.01			F(2.782, 5926.642)=13.757, p<.01		
Deployment	48	3.90	1.06	42	2.52	1.13	1459	3.26	1.10	2128	1.86	.94

Group discussion

The pattern for *Group discussion* was similar although not identical to that for *Whole-class discussion*. Teachers of both age groups perceived that *Group discussion* promoted the four attitudinal aspects similarly, but particularly sense of progress. This contrasted with pupils, particularly those in 8th grade (See Figure 4.2.8 and Table 4.2.8). 5th graders perceived that *Group discussion* promoted sense of progress more than other aspects, while 8th graders perceived that this teaching method promoted pupils' enjoyment and motivation more than other aspects, although this difference was small. Teachers and pupils of both age groups perceived that the frequency of the deployment of *Group discussion* was relatively low; this was particularly marked in the responses of 8th graders.

Figure 4.2.8: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Group discussion*

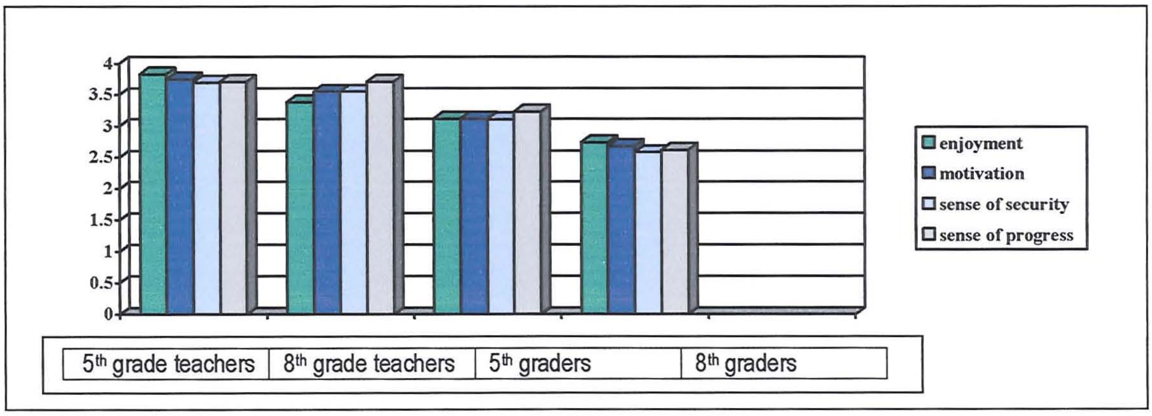


Table 4.2.8: Perceptions of pupils' affective attitudes towards mathematics learning as promoted by *Group discussion*

	5th grade teachers			8th grade teachers			5th graders			8th graders		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Enjoyment	48	3.83	.69	42	3.38	.79	1479	3.12	1.23	2158	2.74	1.31
Motivation	48	3.75	.81	42	3.55	.86	1479	3.12	1.24	2148	2.68	1.28
Sense of security	47	3.70	.72	40	3.55	.78	1474	3.11	1.23	2138	2.58	1.20
Sense of progress	48	3.71	.77	42	3.71	.71	1474	3.23	1.23	2142	2.62	1.19
Repeated measure ANOVA	F(2.335, 107.423)=.723 p>.05			F(2.141, 83.515)=1.536, p>.05			F(2.876, 4221.698)=7.197, P<.01			F(2.800,5956.455)=17.184, P<.01		
Deployment	48	2.46	.92	42	1.90	1.01	1464	2.41	.92	2124	1.53	.77

Summary of 4.2

Teaching methods were overall perceived to promote the four attitudinal aspects to different extents, except in the case of *Whole-class discussion* and *Group discussion* where the differences were small. Teachers appeared to adopt teaching methods which promoted pupils' sense of security and sense of progress rather than enjoyment and motivation. *Teacher explanation, Individual work, Individual help* and *Reading a textbook* fit this category. Pupils of both age groups shared their teachers' view of these methods. Generally, teachers did not adopt, or adopted very infrequently if at all, other methods because they did not perceive these could promote sense of security and sense of progress more than enjoyment and motivation. Teachers and pupils shared the view that *Using a computer* could promote enjoyment and motivation more than sense of security and sense of progress. Pupils, particularly 5th graders, perceived that *Practical work* and discussion could promote sense of progress more than other attitudes, while teachers believed that this teaching method could promote enjoyment and motivation more than sense of security and sense of progress.

4.3: Comparison of the perceptions of participants from each group

4.3.1: Comparison of the perceptions of teachers of different age groups

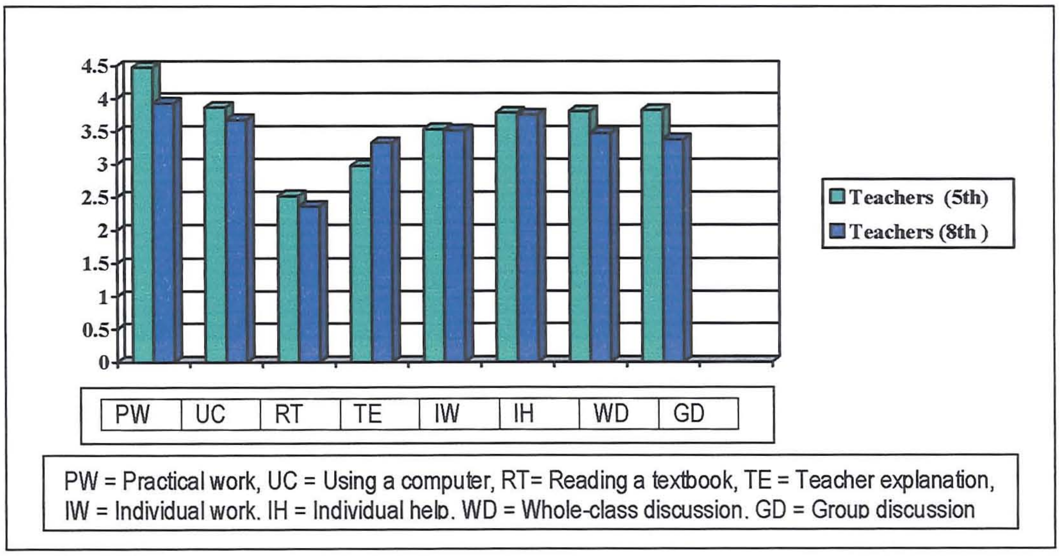
Enjoyment

The mean scores of teachers' perceptions of their pupils attitudes towards learning mathematics were compared using Independent t-tests. The results detailed in Table 4.3.1 and Figure 4.3.1 below showed that 5th grade teachers were likely to perceive that *Practical work* and *Group discussion* promoted enjoyment more than 8th grade teachers. There were no significant differences for the other teaching methods. As a series of t-tests were undertaken a more stringent level of probability ($p<.01$) was adopted than was necessary.

Table 4.3.1: Comparison between teachers of different age groups; enjoyment

		5th grade teachers			8th grade teachers		
		N	Mean	SD	N	Mean	SD
Practical work	t=3.027, df=62.339, Sig. <.01	48	4.48	.58	42	3.93	1.05
Group discussion	t=2.882, df=88, Sig. <.01	48	3.83	.69	42	3.38	.79

Figure 4.3.1: Comparison between teachers of different age groups: enjoyment



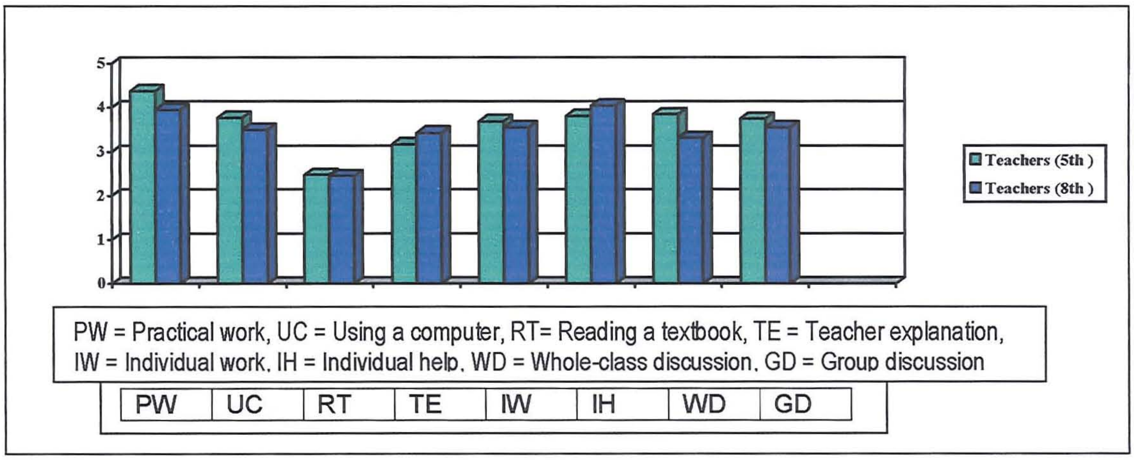
Motivation

The results of Independent t-tests detailed in Table 4.3.2 and Figure 4.3.2 below showed that 5th grade teachers were likely to perceive that *Whole-class discussion* promoted their pupils' motivation more than 8th grade teachers. There were no significant differences for the other teaching methods.

Table 4.3.2: Comparison between teachers of different age groups; motivation

		5th grade teachers			8th grade teachers		
		N	Mean	SD	N	Mean	SD
Whole-class Discussion	t=3.000, df=88, Sig. <.01	48	3.85	.87	42	3.31	.84

Figure 4.3.2: Comparison between teachers of different age groups; motivation



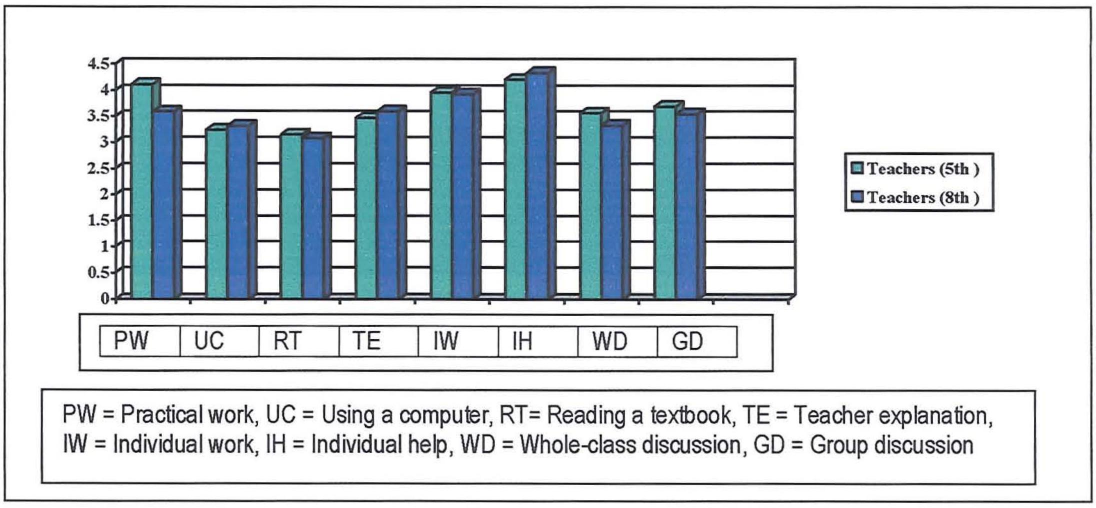
A sense of security

The results of Independent t-tests detailed in Table 4.3.3 and Figure 4.3.3 below showed that 5th grade teachers were likely to perceive that *Practical work* promoted sense of security more than 8th grade teachers. There were no significant differences for the other teaching methods.

Table 4.3.3: Comparison between teachers of both teaching age groups; a sense of security

		5th grade teachers			8th grade teachers		
		N	Mean	SD	N	Mean	SD
Practical Work	t=3.166, df=73.108, Sig. <.01	47	4.11	.67	39	3.59	.82

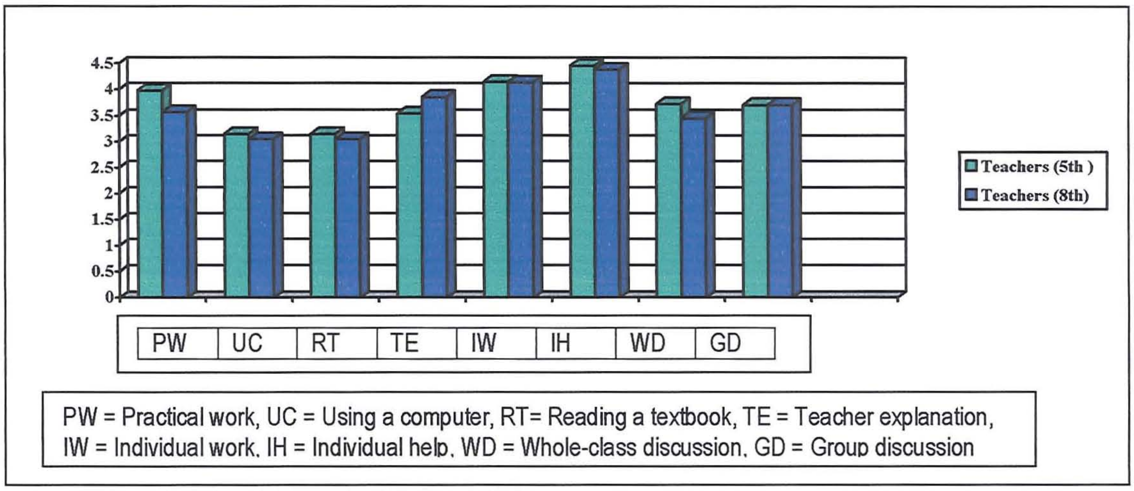
Figure 4.3.3: Comparison between teachers of both teaching age groups; a sense of security



A sense of progress

There was no significant difference in the teachers' perceptions of the extent to which sense of progress was promoted by different teaching methods (See Figure 4.3.4). Overall, *Individual help* and *Individual work* were seen as the most supportive of a sense of progress.

Figure 4.3.4: Comparison between teachers of both teaching age groups; a sense of progress



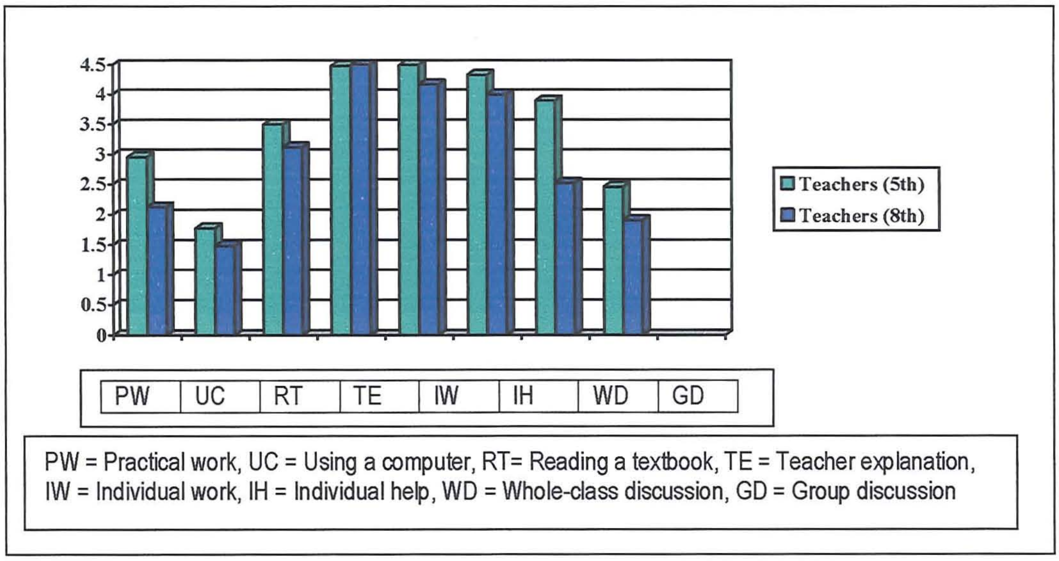
Deployment

The results of Independent t-tests detailed in Table 4.3.4 and Figure 4.3.5 below showed that 5th grade teachers were more likely to deploy *Practical work, Whole-class discussion* and *Group discussion* than 8th grade teachers. Overall, the most deployed methods as perceived by teachers were *Teacher explanation*, *Individual work* and *Individual help*.

Table 4.3.4: Comparison between teachers of both teaching age groups; deployment

		5th grade teachers			8th grade teachers		
		N	Mean	SD	N	Mean	SD
Practical work	t=4.879, df=88, Sig. <.01	48	2.96	.77	42	2.12	.86
Whole-class Discussion	t=5.946, df=88, Sig. <.01	48	3.90	1.06	42	2.52	1.13
Group discussion	t=2.722, df=88, Sig. <.01	48	2.46	.92	42	1.90	1.01

Figure 4.3.5: Comparison between teachers of both teaching age groups; deployment



Summary

Overall the comparisons showed that 5th grade teachers reported more frequent deployment of *Practical work*, *Whole-class discussion* and *Group discussion.* They were more likely to perceive that these teaching methods promoted pupils' positive attitudes than 8th grade teachers. They were also more likely to perceive that:

- *Practical work* promoted enjoyment and sense of security;
- *Whole-class discussion* promoted motivation;

- *Group discussion* promoted enjoyment.

No significant differences were found in the reported frequencies of deployment of *Using a computer*, *Reading a textbook, Teacher explanation*, *Individual work* and *Individual help.* In addition, no significant differences were found in the perceptions of the extent to which these teaching methods positively promoted pupils' attitudes.

4.3.2: Comparison of the perceptions of pupils of different age groups

Enjoyment

The results of a series of Independent t-tests outlined in Table 4.3.5 and Figure 4.3.6 below showed that 5th graders were more likely to perceive that *Practical work, Using a computer, Reading a textbook, Whole-class discussion* and *Group discussion* promoted their enjoyment than 8th graders. As before a significant level of <. 01 was adopted.

Table 4.3.5:Comparison between 5th and 8th graders: enjoyment (1)

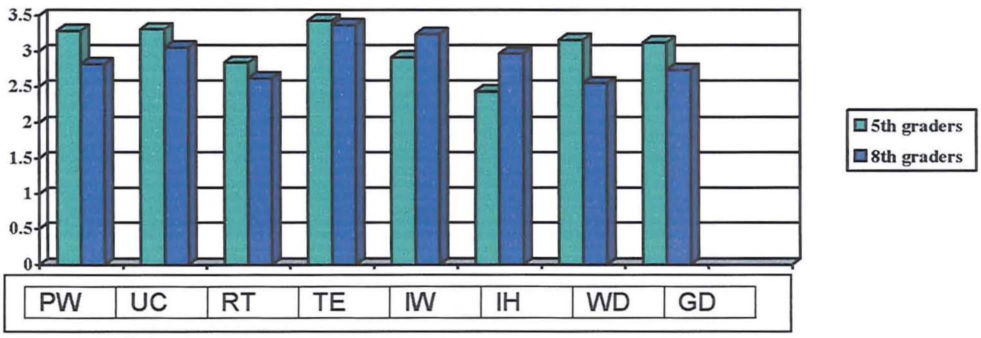
		5th graders			8th graders		
		N	Mean	SD	N	Mean	SD
Practical work	t=10.235, df=3633, Sig. <.01	1479	3.29	1.33	2156	2.82	1.36
Using Computer	t=4.990, df=3106.694, Sig. <.01	1476	3.31	1.56	2155	3.05	1.52
Reading Textbooks	t=5.506, df=3180.092, Sig. <.01	1475	2.84	1.18	2154	2.62	1.19
Whole-class Discussion	t=14.982, df=3195.813, Sig. <. 01	1479	3.16	1.21	2156	2.55	1.22
Group discussion	t=8.951, df=3303.573, Sig.<.01	1479	3.12	1.23	2156	2.74	1.31

The results of Independent t-tests detailed in Table 4.3.6 and Figure 4.3.6 show that 8th graders were more likely to perceive that *Individual work* and *Individual help* promoted their enjoyment than 5th graders. Overall, enjoyment was seen to be most promoted by *Teacher explanation* by both age groups.

Table 4.3.6: Comparison between 5th and 8th graders: enjoyment (2)

		5th graders			8th graders		
		N	Mean	SD	N	Mean	SD
Individual Work	t= 7.317, df=3633, Sig.<.01	1479	2.92	1.32	2156	3.24	1.26
Individual Help	t= 12.154, df=3626, Sig. <.01	1472	2.44	1.23	2156	2.97	1.32

Figure 4.3.6: Comparison between 5th and 8th graders: enjoyment



PW = Practical work, UC = Using a computer, RT= Reading a textbook, TE = Teacher explanation, IW = Individual work, IH = Individual help, WD = Whole-class discussion, GD = Group discussion

Motivation

The results of Independent t-tests detailed in Table 4.3.7 and Figure 4.3.7 show that 5th graders were more likely to perceive that *Practical work, Using a computer, Reading a textbook, Whole-class discussion* and *Group discussion* promoted motivation than 8th graders.

Table 4.3.7: Comparison between 5th and 8th graders: motivation (1)

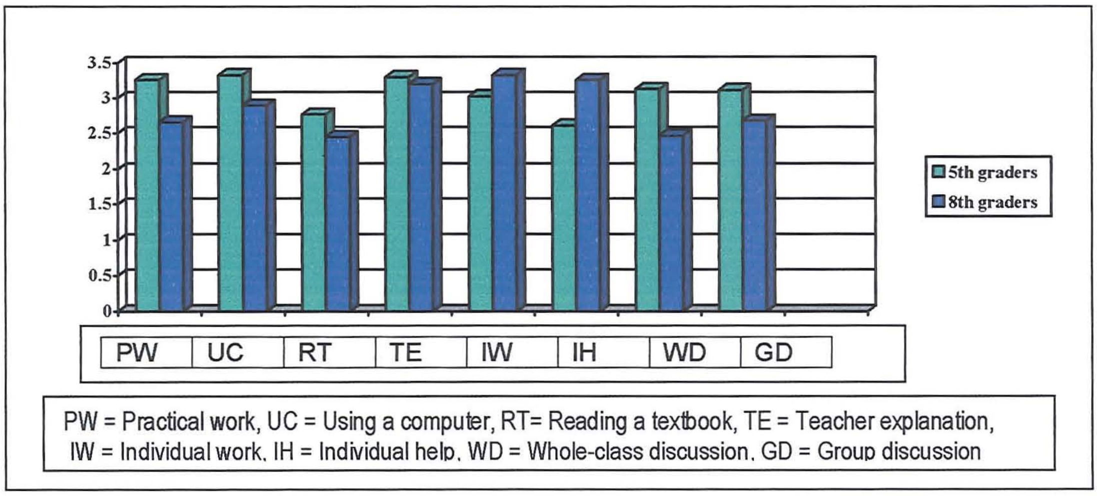
		5th graders			8th graders		
		N	Mean	SD	N	Mean	SD
Practical Work	t=13.671, df=3626, Sig. =<.01	1479	3.26	1.34	2149	2.66	1.29
Using a Computer	t=8.824, df=3020.635, Sig.<.01	1476	3.33	1.50	2147	2.90	1.39
Reading a Textbook	t=7.614, df=2995.652, Sig. <.01	1476	2.77	1.28	2142	2.45	1.17
Whole-class Discussion	t=16.250, df=3626, Sig. <.01	1479	3.13	1.24	2149	2.47	1.19
Group Discussion	t=10.344, df=3239.884, Sig. <.01	1479	3.12	1.24	2148	2.68	1.28

The results of Independent t-tests detailed in Table 4.3.8 and Figure 4.3.7 show that 8th graders were more likely to perceive that *Individual work* and *Individual help* promoted motivation than 5th graders.

Table 4.3.8: Comparison between 5th and 8th graders: motivation (2)

		5th graders			8th graders		
		N	Mean	SD	N	Mean	SD
Individual Work	t= 6.687, df=3002.869, Sig. <.01	1479	3.03	1.40	2148	3.33	1.29
Individual Help	t= 14.175, df=3624, Sig.<.01	1477	2.61	1.34	2149	3.26	1.35

Figure 4.3.7: Comparison between 5th and 8th graders: motivation



A sense of security

Table 4.3.9: Comparison between 5th and 8th graders: a sense of security (1)

		5th graders			8th graders		
		N	Mean	SD	N	Mean	SD
Practical Work	t=15.242, df=2995.078, Sig. <.01	1473	3.18	1.30	2141	2.53	1.20
Using a Computer	t=10.149, df=2884.117, Sig. <.01	1472	3.09	1.46	2138	2.61	1.28
Reading a Textbook	t=3.817, df=3610, Sig.<.01	1471	2.96	1.32	2141	2.79	1.24
Whole-class Discussion	t=17.515, df=3612, Sig. <.01	1474	3.12	1.26	2140	2.41	1.14
Group Discussion	t=12.982, df=3610, Sig. <.01	1474	3.11	1.23	2138	2.58	1.20

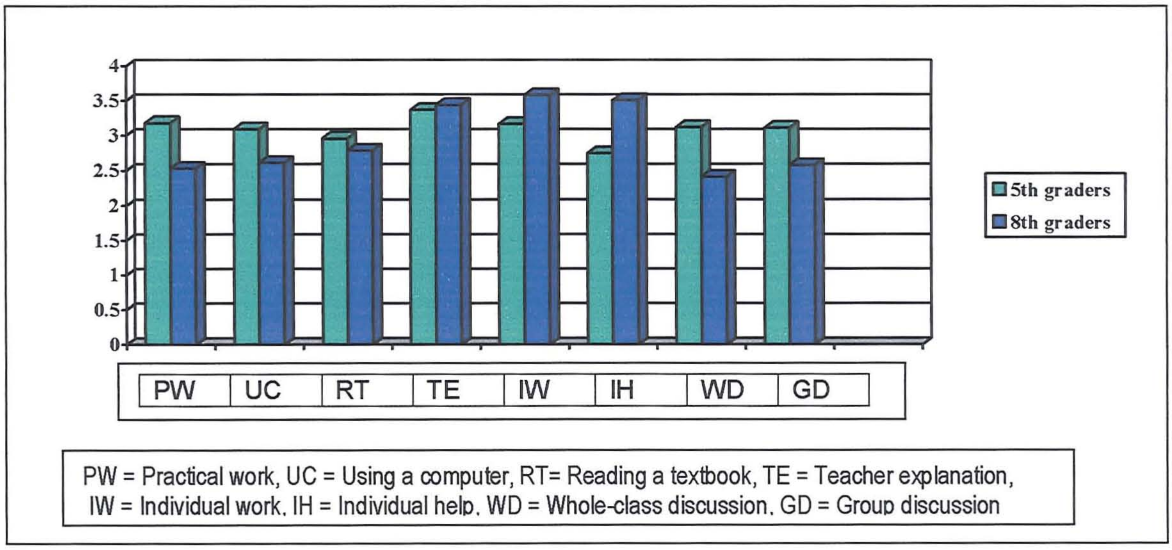
The results of independent t-tests outlined in Table 4.3.9 and Figure 4.3.8 show that 5th graders were more likely to perceive that *Practical work, Using a computer, Reading a textbook, Whole-class discussion* and *Group discussion* promoted sense of security more than 8th graders.

The results of Independent t-tests detailed in Table 4.3.10 and Figure 4.3.8 show that 8th graders were more likely to perceive that *Individual work* and *Individual help* promoted sense of security than 5th graders.

Table 4.3.10: Comparison between 5th and 8th graders: a sense of security (2)

		5th graders			8th graders		
		N	Mean	SD	N	Mean	SD
Individual Work	t=-9.058, df=2982.577, Sig.<.01	1474	3.17	1.39	2141	3.58	1.27
Individual Help	t=16.577, df=3611, Sig. <.01	1473	2.75	1.37	2140	3.51	1.33

Figure 4.3.8: Comparison between 5th and 8th graders: a sense of security



A sense of progress

The results of Independent t-tests detailed in Table 4.3.11 and Figure 4.3.9 show that 5th graders were likely to perceive that *Practical work, Using a computer, Reading a textbook, Whole-class discussion* and *Group discussion* promoted a sense of progress more than 8th graders.

Table 4.3.11: Comparison between 5th and 8th graders: a sense of progress (1)

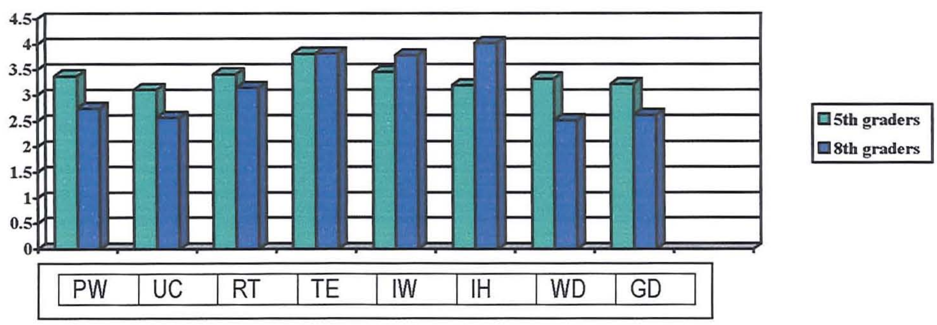
		5th graders			8th graders		
		N	Mean	SD	N	Mean	SD
Practical Work	t=14.490, df=3073.156, Sig. <.01	1474	3.38	1.31	2143	2.75	1.26
Using a Computer	t=12.081, df=2898.757, Sig. <.01	1469	3.11	1.37	2138	2.57	1.22
Reading a Textbook	t=6.171, df=3022.550, Sig. <.01	1473	3.42	1.34	2141	3.15	1.26
Whole-class Discussion	t=19.534, df=2950.471, Sig. <.01	1476	3.33	1.28	2143	2.52	1.15
Group Discussion	t=14.914, df=3614, Sig. <.01	1474	3.23	1.23	2142	2.62	1.19

The results of Independent t-tests outlined in Table 4.3.12 and Figure 4.3.9 show that 8th graders were likely to perceive that *Individual work* and *Individual help* promoted sense of progress more than 5th graders.

Table 4.3.12: Comparison between 5th and 8th graders: a sense of progress (2)

		5th graders			8th graders		
		N	Mean	SD	N	Mean	SD
Individual Work	t= 7.868, df=2867.825, Sig. <.01	1476	3.46	1.34	2143	3.79	1.16
Individual Help	t= 18.842, df=2760.664, Sig. <.01	1475	3.20	1.39	2142	4.03	1.15

Figure 4.3.9: Comparison between 5th and 8th graders: a sense of progress



PW = Practical work, UC = Using a computer, RT= Reading a textbook, TE = Teacher explanation, IW = Individual work, IH = Individual help, WD = Whole-class discussion, GD = Group discussion

Deployment

The results of Independent t-tests detailed in Table 4.3.13 and Figure 4.3.10 show that 5th graders were likely to perceive that *Practical work, Using a computer, Reading a* *textbook*, *Whole-class discussion* and *Group discussion* were deployed more frequently than 8th graders perceived.

Table 4.3.13: Comparison between 5th and 8th graders: deployment (1)

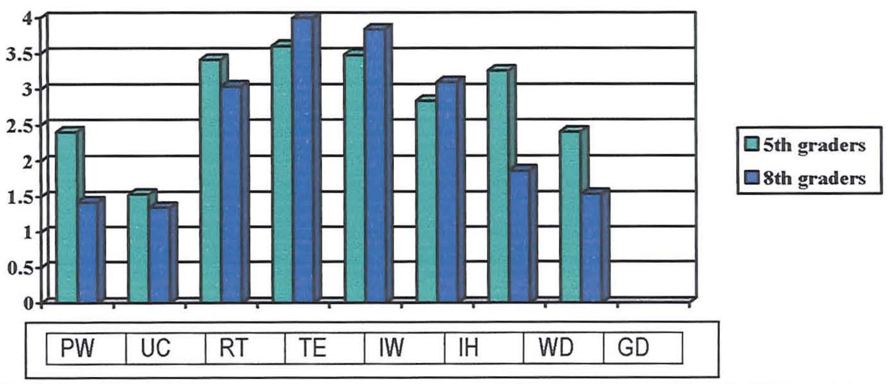
		5th graders			8th graders		
		N	Mean	SD	N	Mean	SD
Practical Work	t=36.409, df=2356.045, Sig. <.01	1476	2.41	.92	2142	1.42	.61
Using Computer	t=7.543, df=2783.661, Sig. <.01	1473	1.53	.80	2143	1.34	.67
Reading Textbooks	t=10.558, df=3464.609, Sig. <.01	1473	3.41	.97	2136	3.04	1.15
Whole-class Discussion	t=39.511, df=2803.447, Sig. <.01	1459	3.26	1.10	2128	1.86	.94
Group Discussion	t=29.930, df=2772.860, Sig. <.01	1463	2.41	.92	2124	1.53	.77

The results of Independent t-tests outlined in Table 4.3.14 and Figure 4.3.10 show that 8th graders were more likely to perceive that their teachers deployed *Teacher explanation, Individual work* and *Individual help* than 5th graders. There were significant differences between 5th and 8th graders in the perceptions of deployment of all teaching methods.

Table 4.3.14: Comparison between 5th and 8th graders: deployment (2)

		5th graders			8th graders		
		N	Mean	SD	N	Mean	SD
Teacher explanation	t= 11.108, df=3077.741, Sig. <.01	1467	3.61	1.05	2134	4.00	1.01
Individual work	t= 10.767, df=2933.929, Sig. <.01	1467	3.48	1.00	2134	3.84	.90
Individual help	t= 7.485, df=3272.932, Sig. <.01	1472	2.84	1.03	2134	3.10	1.09

Figure 4.3.10: Comparison between 5th and 8th graders: deployment



PW = Practical work, UC = Using a computer, RT= Reading a textbook, TE = Teacher explanation, IW = Individual work, IH = Individual help, WD = Whole-class discussion, GD = Group discussion

Summary

The results of the t-tests showed that 5th graders reported more frequent deployment by their teachers of *Practical work*, *Using computer*, *Reading textbook*, *Whole-class discussion* and *Group discussion* than 8th graders. In addition, 5th graders were more likely to perceive that these teaching methods promoted positive attitudes than 8th graders. 8th graders reported more frequent deployment of *Teacher explanation*, *Individual work* and *Individual help* than 5th graders, and were more likely to perceive that *Individual work* and *Individual help* would have positive effects than 5th graders. No significant difference was found in the perceived effects of *Teacher explanation* on attitudes between the pupil groups.

4.3.3: Comparison of perceptions between 5th grader teachers and their pupils

Because of large differences in the sample sizes for the teacher and pupil participants it was not possible to use Inferential statistics to make comparisons. To overcome this, the concept of effect size was used. Effect size is usually used in meta-analysis to examine the effect across many studies. Glass et al. (1981) developed a formula for calculating effect sizes, which they referred to as d. In the formula,

d = [Mean of experimental group minus Mean of control group divided by Standard Deviation of control group].

The assumption is that there may be a noticeable difference between two groups where the mean score of the group which has a higher mean score minus the mean score of the group which has a lower mean score divided by the standard deviation of the group which has a lower mean score is over .50.

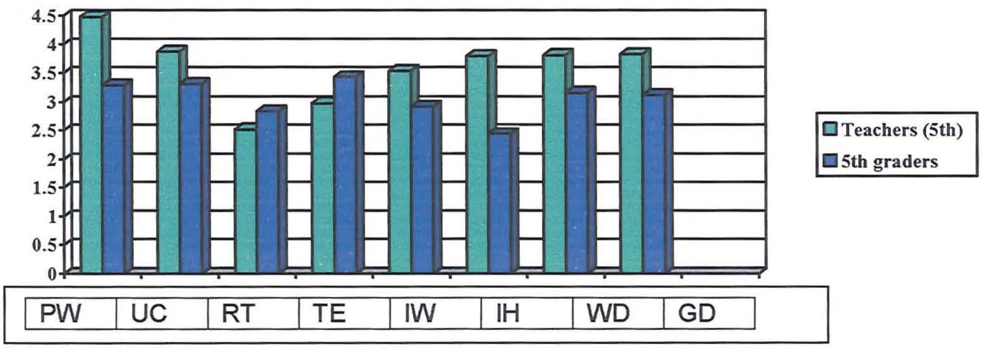
Enjoyment

Table 4.3.15 and Figure 4.3.11 show that 5th grade teachers were likely to perceive that *Practical work, Individual help, Whole-class discussion* and *Group discussion* promoted enjoyment more than their pupils. Pupil responses exceeded those of their teachers only in relation to *Teacher explanation* and *Reading a textbook* but these did not have an effect size of more than .50.

Table 4.3.15: Comparison between 5th grade teachers and their pupils; enjoyment

	5th grade teachers	5th graders	Effect size d
Practical work	M=4.48, SD=.58	M=3.29,SD=1.33	.89
Individual help	M=3.79, SD=.85	M=2.44,SD=1.23	1.10
Whole-class discussion	M=3.81, SD=. 82	M=3.16,SD=1.21	.54
Group discussion	M=3.83, SD=. 69	M=3.12,SD=1.23	.58

Figure 4.3.11: Comparison between 5th grade teachers and their pupils; enjoyment



PW = Practical work, UC = Using a computer, RT= Reading a textbook, TE = Teacher explanation, IW = Individual work, IH = Individual help, WD = Whole-class discussion, GD = Group discussion

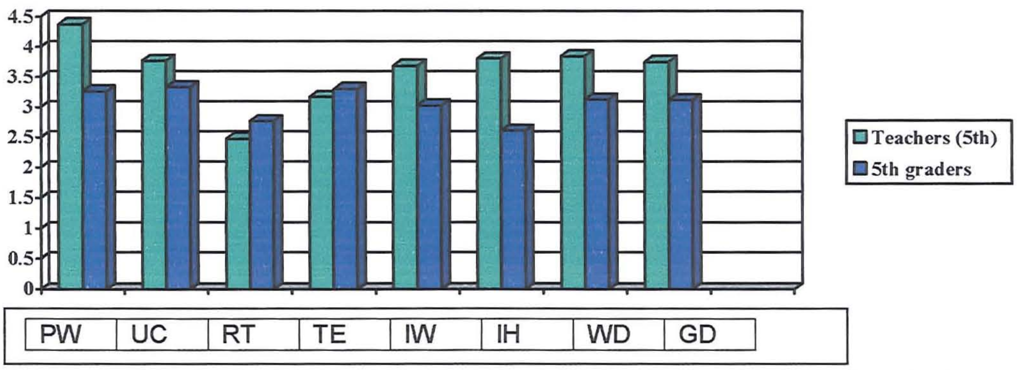
Motivation

Table 4.3.16 and Figure 4.3.12 show that 5th grade teachers were likely to perceive that *Practical work, Individual help, Whole-class discussion* and *Group discussion* promoted motivation more than their pupils. As for enjoyment, pupils perceived only *Teacher explanation* and *Reading a textbook* more positively. These differences were very small.

Table 4.3.16: Comparison between teachers of 5th graders and their pupils; motivation

	5th grade teachers	5th graders	Effect size d
Practical work	M=4.38, SD=. 79	M=3.26, SD=1.34	.84
Individual help	M=3.81, SD=.94	M=2.61, SD=1.34	.90
Whole-class discussion	M=3.85, SD=.87	M=3.13, SD=1.24	.58
Group discussion	M=3.75, SD=.81	M=3.12, SD=1.24	.51

Figure 4.3.12: Comparison between 5th grade teachers and their pupils; perceptions of motivation



PW = Practical work, UC = Using a computer, RT= Reading a textbook, TE = Teacher explanation, IW = Individual work. IH = Individual help. WD = Whole-class discussion. GD = Group discussion

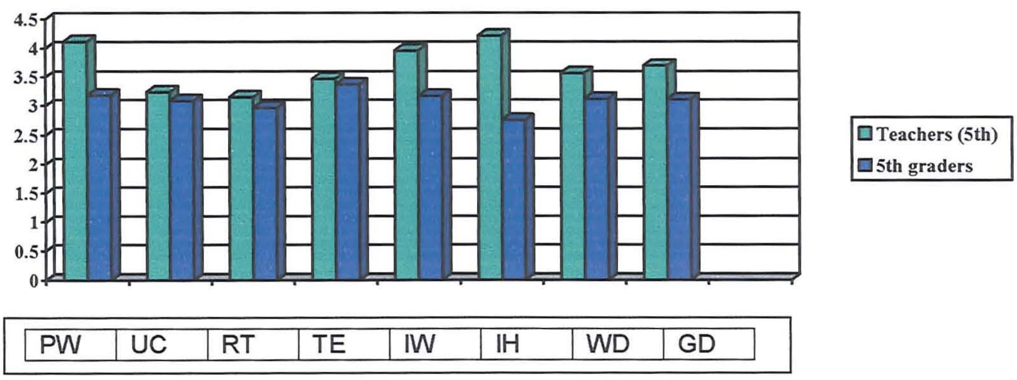
A sense of security

Table 4.3.17 and Figure 4.3.13 show that 5th grade teachers were more likely to perceive that several teaching methods promoted a sense of security than their pupils; *Practical work, Individual work* and *Individual help* showed effects greater than .50.

Table 4.3.17: Comparison between 5th grade teachers and their pupils; a sense of security

	5th grade teachers	5th graders	Effect size d
Practical work	M=4.11, SD=.67	M=3.18, SD=1.30	.72
Individual work	M=3.96, SD=.72	M=3.17, SD=1.39	.57
Individual help	M=4.21, SD=.81	M=2.75, SD=1.37	1.07

Figure 4.3.13: Comparison between 5th grade teachers and their pupils; perceptions of sense of security



PW = Practical work, UC = Using a computer, RT= Reading a textbook, TE = Teacher explanation, IW = Individual work. IH = Individual help. WD = Whole-class discussion. GD = Group discussion

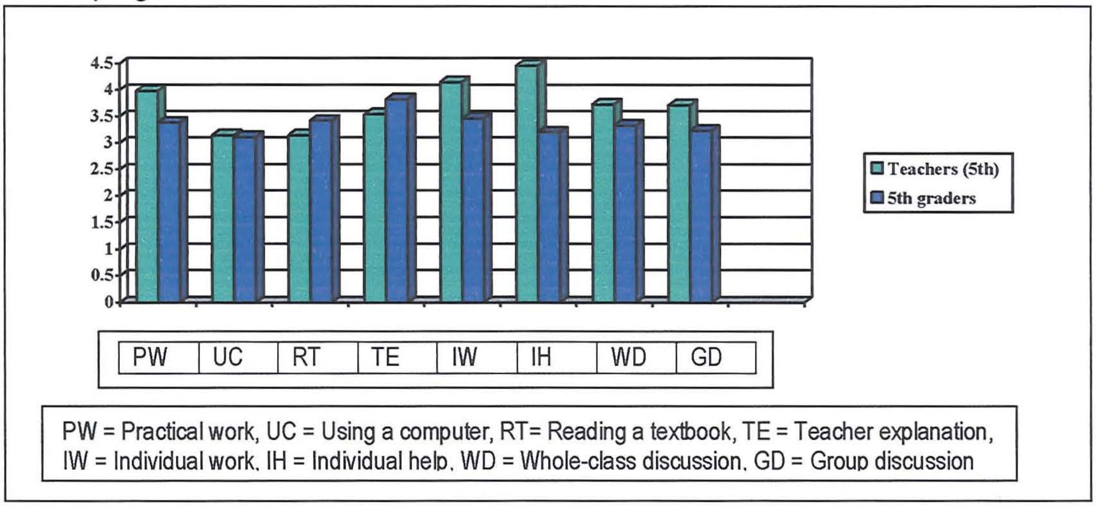
A sense of progress

Table 4.3.18 and Figure 4.3.14 show the teachers were more likely to perceive that *Individual work* and *Individual help* promoted a sense of progress than their pupils. These teaching methods had an effect size greater than .5.

Table 4.3.18: Comparison between 5th grade teachers and their pupils; a sense of progress

	5th grade teachers	5th graders	Effect size d
Individual work	M=4.15, SD=.68	M=3.46, SD=1.34	.51
Individual help	M=4.46, SD=.77	M=3.20, SD=1.39	.91

Figure 4.3.14: Comparison between 5th grade teachers and their pupils; perceptions of sense of progress



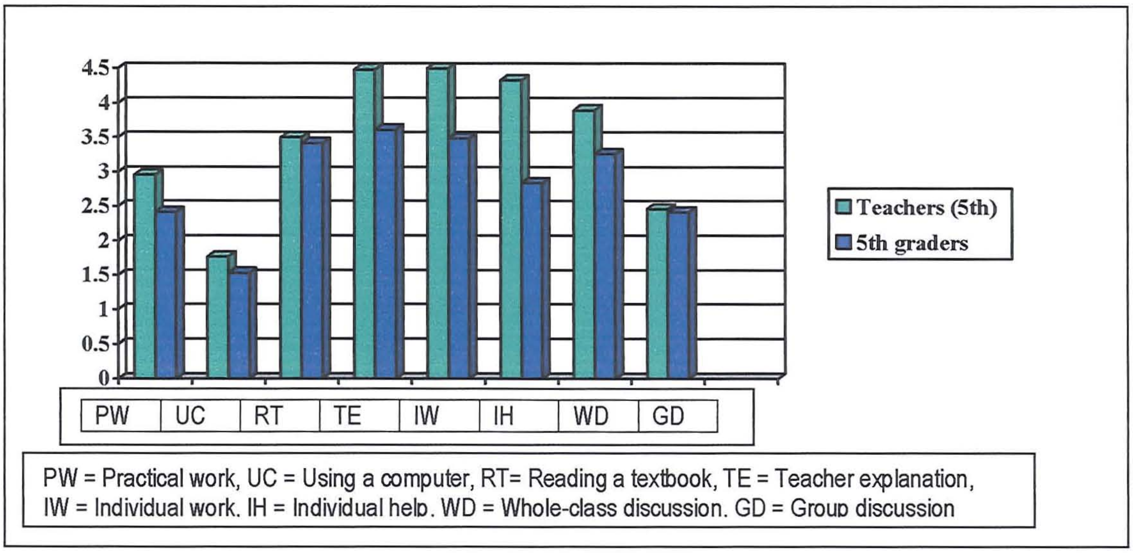
Deployment

Table 4.3.19 and Figure 4.3.15 show that the teachers were more likely to report that *Practical work, Teacher explanation, Individual work, Individual help* and *Whole-class discussion* were deployed in their classes than their pupils. The effect sizes are at least .5 and in some cases greater than 1.

Table 4.3.19: Comparison between 5th grade teachers and their pupils; deployment

	5th grade teachers	5th graders	Effect size d
Practical work	M=2.96, SD=. 77	M=2.41, SD=. 92	.60
Teacher explanation	M=4.48, SD=. 65	M=3.61, SD=1.05	.83
Individual work	M=4.50, SD=. 65	M=3.48, SD=1.00	1.02
Individual help	M=4.33, SD=. 63	M=2.84, SD=1.03	1.45
Whole-class discussion	M=3.90, SD=1.06	M=3.26, SD=1.10	.58

Figure 4.3.15: Comparison between 5th grade teachers and their pupils; perceptions of deployment



Summary

The results of this analysis show that 5th grade teachers were likely to have stronger perceptions than their pupils of the frequency of the deployment of some teaching methods and the extent to which these teaching methods promoted positive attitudes. 5th grade teachers were more likely to perceive that *Practical work*, *Teacher explanation, Individual work*, *Individual help* and *Whole-class discussion* were deployed in their mathematics classes more than their pupils and that these teaching methods except for *Teacher explanation* promoted pupils' positive affective attitudes towards mathematics learning more than their pupils.

4.3.4: Comparison of perceptions between 8th grade teachers and their pupils

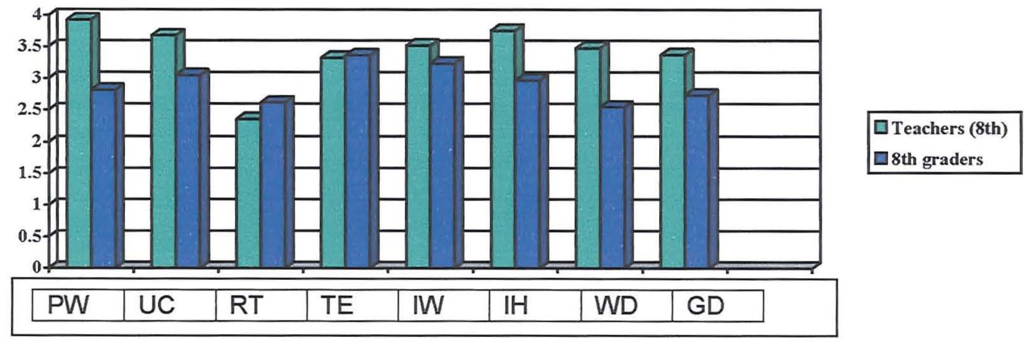
Enjoyment

Table 4.3.20 and Figure 4.3.16 show that 8th grade teachers were more likely than their pupils to perceive that *Practical work, Individual help* and *Whole-class discussion* promoted enjoyment with an effect size greater than .5. As with 5th graders, only *Teacher explanation* and *Reading a textbook* were perceived to promote enjoyment more by pupils than teachers, although these differences were very small.

Table 4.3.20: Comparison between 8th grade teachers and their pupils; enjoyment

	Teachers of 8th graders	8th graders	Effect size d
Practical work	M=3.93, SD=1.05	M=2.82, SD=1.36	.82
Individual help	M=3.76, SD=. 82	M=2.97, SD=1.32	.60
Whole-class discussion	M=3.48, SD=. 71	M=2.55, SD=1.22	.76

Figure 4.3.16: Comparison between 8th grade teachers and their pupils; perceptions of enjoyment



PW = Practical work, UC = Using a computer, RT= Reading a textbook, TE = Teacher explanation, IW = Individual work, IH = Individual help, WD = Whole-class discussion, GD = Group discussion

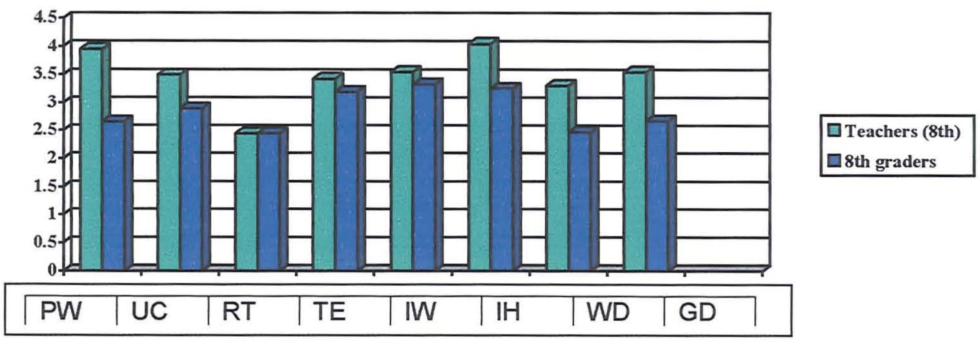
Motivation

Table 4.3.21 and Figure 4.3.17 show that 8th grade teachers were more likely than their pupils to perceive that *Practical work, Using a computer, Individual help, Whole-class discussion* and *Group discussion* promoted motivation, with an effect size greater than .5. All of the teacher responses in relation to motivation were higher than those of their pupils.

Table 4.3.21: Comparison between 8th grade teachers and their pupils; motivation

	8th grade teachers	8th graders	Effect size d
Practical work	M=3.95, SD=. 76	M=2.66, SD=1.29	1.0
Using a computer	M=3.50, SD=. 78	M=2.90, SD=1.39	.58
Individual help	M=4.05, SD=. 73	M=3.26, SD=1.35	.59
Whole-class discussion	M=3.31, SD=. 84	M=2.47, SD=1.19	.71
Group discussion	M=3.55, SD=. 86	M=2.68, SD=1.28	.68

Figure 4.3.17: Comparison between 8th grade teachers and their pupils; perceptions of motivation



PW = Practical work, UC = Using a computer, RT= Reading a textbook, TE = Teacher explanation, IW = Individual work. IH = Individual help. WD = Whole-class discussion. GD = Group discussion

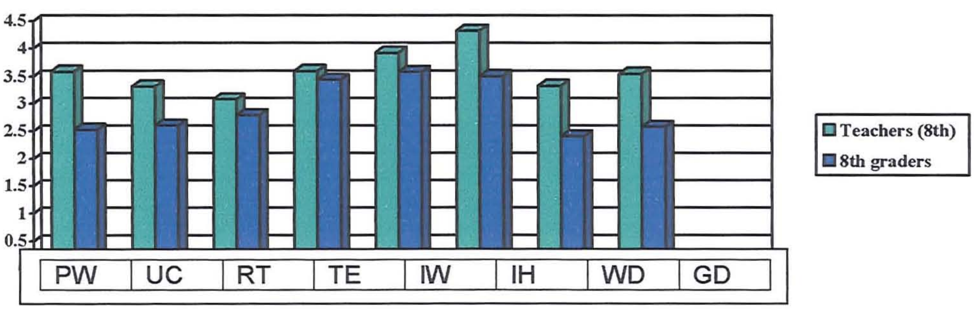
A sense of security

Table 4.3.22 and Figure 4.3.18 show that 8th grade teachers were more likely than their pupils to perceive that *Practical work, Using a computer, Individual help, Whole-class discussion* and *Group discussion* promoted sense of security, with an effect size greater than .5. In all cases, teachers' responses were more positive than their pupils.

Table 4.3.22: Comparison between 8th grade teachers and their pupils; a sense of security

	8th grade teachers	8th graders	Effect size d
Practical work	M=3.59, SD=. 82	M=2.53, SD=1.20	.88
Using a computer	M=3.32, SD=. 66	M=2.61, SD=1.28	.55
Individual help	M=4.33, SD=. 73	M=3.51, SD=1.33	.62
Whole-class discussion	M=3.33, SD=. 73	M=2.41, SD=1.14	.81
Group discussion	M=3.55, SD=. 78	M=2.58, SD=1.20	.81

Figure 4.3.18: Comparison between 8th grade teachers and their pupils; perceptions of a sense of security



PW = Practical work, UC = Using a computer, RT= Reading a textbook, TE = Teacher explanation, IW = Individual work. IH = Individual help. WD = Whole-class discussion. GD = Group discussion

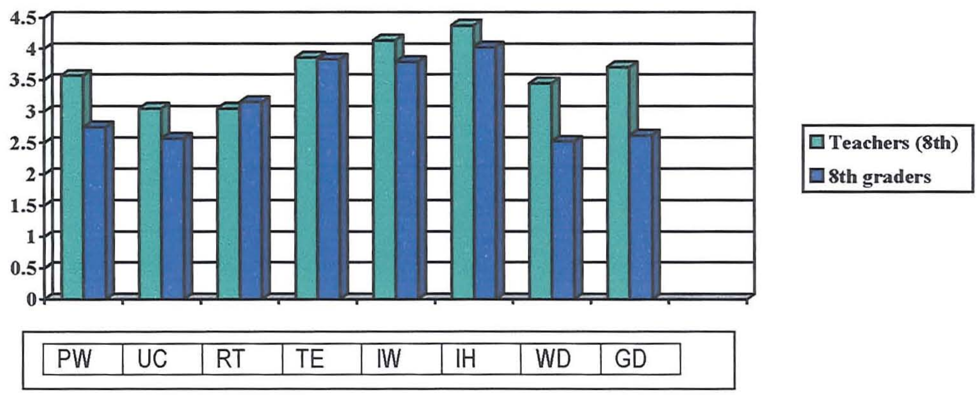
A sense of progress

Table 4.3.23 and Figure 4.3.19 show that 8th grade teachers were more likely to perceive that *Practical work, Whole-class discussion* and *Group discussion* promoted sense of progress than their pupils, with an effect size greater than .5. Only in the case of *Reading a textbook* was there any more positive response from pupils.

Table 4.3.23: Comparison between 8th grade teachers and their pupils; a sense of progress

	8th grade teachers	8th graders	Effect size d
Practical work	M=3.57, SD=. 83	M=2.75, SD=1.26	.65
Whole-class discussion	M=3.45, SD=. 74	M=2.52, SD=1.15	.81
Group discussion	M=3.71, SD=.71	M=2.62, SD=1.19	.92

Figure 4.3.19: Comparison between 8th grade teachers and their pupils; perceptions of a sense of progress



PW = Practical work, UC = Using a computer, RT= Reading a textbook, TE = Teacher explanation, IW = Individual work, IH = Individual help, WD = Whole-class discussion, GD = Group discussion

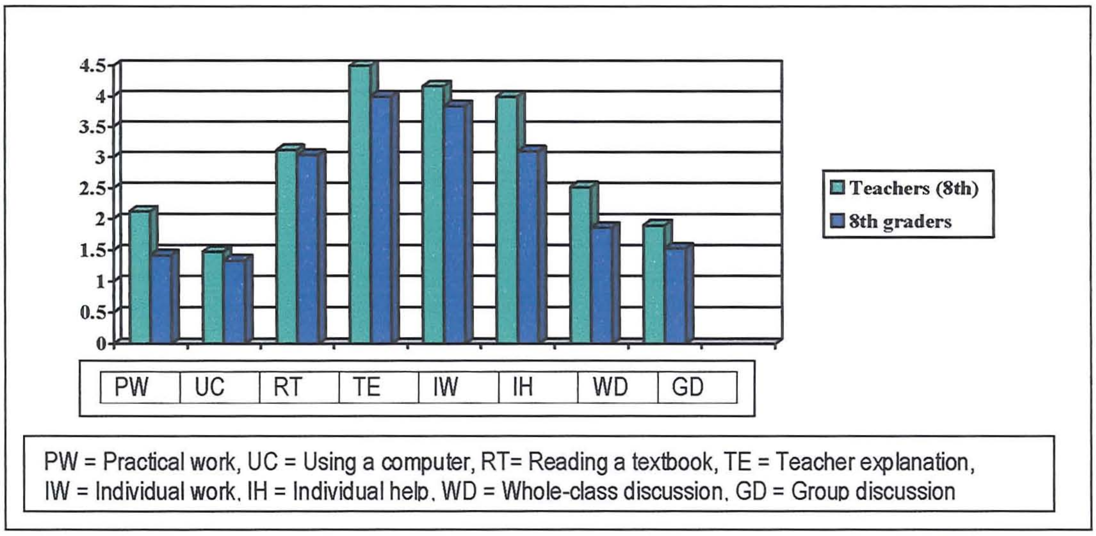
Deployment

Table 4.3.24 and Figure 4.3.20 show that 8th grade teachers reported more frequent deployment of *Practical work, Individual help* and *Whole-class discussion* than their pupils. The differences in perceptions of deployment of different methods were less than at 5th grade but were still substantial.

Table 4.3.24: Comparison between 8^{th} grade teachers and their pupils; deployment

	8th grade teachers	8th graders	Effect size d
Practical work	M=2.12, SD=. 86	M=1.42, SD=. 61	1.15
Individual help	M=4.00, SD=. 86	M=3.10, SD=1.09	.83
Whole-class discussion	M=2.52, SD=1.13	M=1.86, SD=. 94	.70

Figure 4.3.20: Comparison between 8^{th} grade teachers and their pupils; perceptions of deployment



Summary

The results of the data analysis show that 8^{th} grade teachers were likely to have stronger perceptions of the frequency of the deployment of all teaching methods, and the extent to which these teaching methods promoted pupils' affective attitudes, than their pupils. The differences were particularly strong in the case of *Practical work*, *Individual help* and *Whole-class discussion.*

4.3.5: Summary of 4.3

The findings reported in this section have shown that:

- *Practical work*, *Whole-class discussion* and *Group discussion* were more likely to be deployed and preferred by teachers of 5^{th} graders than teachers of 8^{th} graders.
- *Practical work, Using a computer, Reading a textbook, Whole-class discussion* and *Group discussion* were perceived as being more frequently being deployed and more preferred by 5^{th} graders than 8^{th} graders.

- *Individual work* and *Individual help* were perceived as being more frequently deployed and more preferred by 8th graders than 5th graders.
- *Teacher explanation* was perceived as being more frequently deployed by 8th graders than 5th graders, but no significant difference was found in the pupils' perceptions of the extent to which this method promoted positive affective attitudes.

Overall, pupils' perceptions of which teaching methods support learning seem to match what is on offer. Teachers of both grades were more positive in their responses regarding the deployment and impact of teaching methods than their pupils.

4.4: Relationships between teaching methods in promoting positive attitudes towards mathematics learning

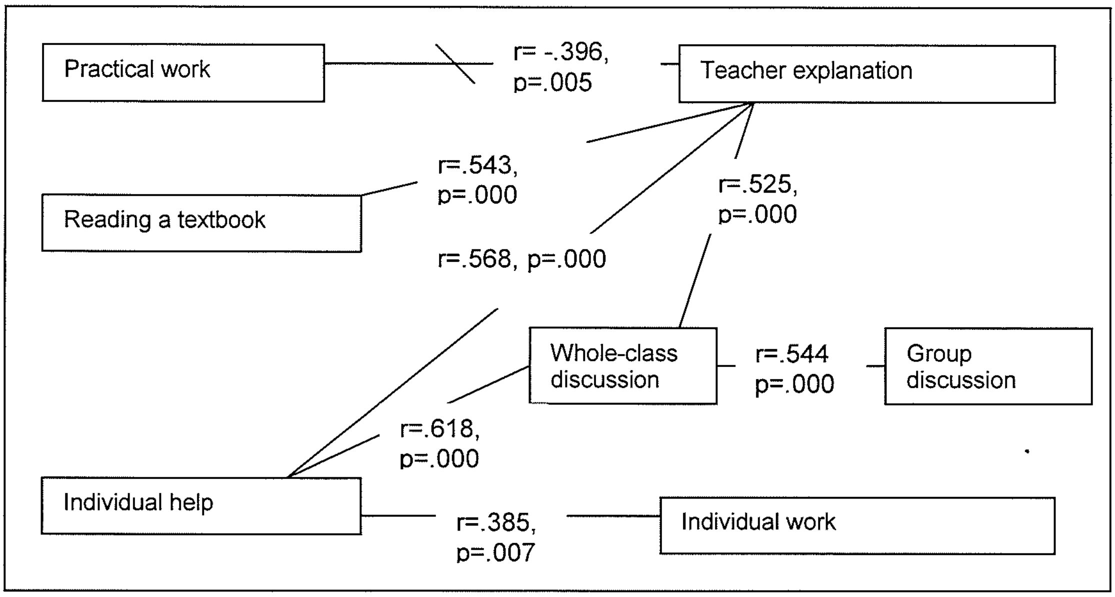
This section examines how the teaching methods taken up in this study were related to each other in promoting pupils' attitudes to mathematics learning. A series of Pearson Product-moment correlations were undertaken. The findings in previous sections suggested that both teachers and pupils perceived that the different teaching methods promoted pupils' positive affective attitudes differently. For instance, *Practical work* and *Using a computer* were perceived as more enjoyable than *Reading a textbook*. The findings in this section explore these relationships. Positive correlations indicate that the participants evaluating one teaching method highly in relation to a particular affective outcome positively evaluate the other teaching method as well, even if one method might be perceived to be less positively promoted than the other teaching method. Negative relationships indicate that participants perceive that these teaching methods might be opposed in terms of promoting a particular aspect of pupils' affective attitudes.

This section also examines the relationships between teaching methods in terms of their frequency of deployment. The findings reported in section 4.1 suggested that teachers and pupils perceived differently the frequency of deployment of teaching methods. If a positive relationship is found between teaching methods in terms of frequency, the participants perceive that these teaching methods are deployed to a similar extent.

Enjoyment

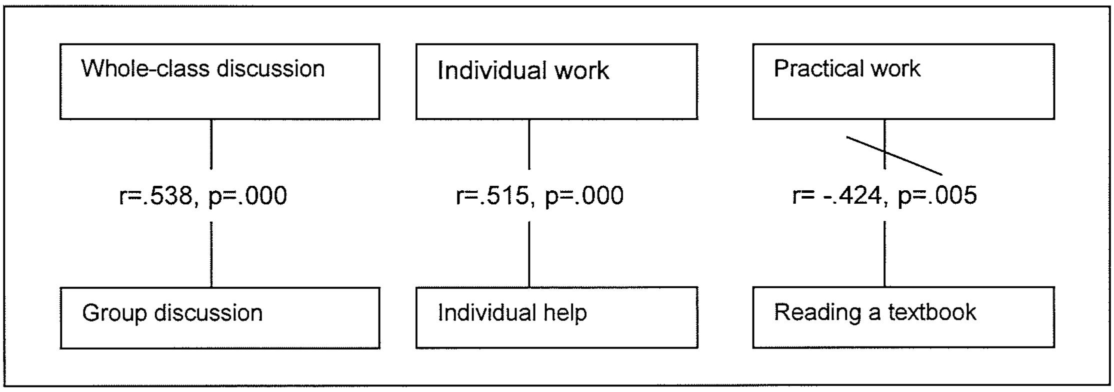
Figure 4.4.1 below shows that there were significant moderate positive correlations between several teaching methods, with respect to enjoyment in the responses of 5th grade teachers. The effects of the teaching methods were correlated in a relatively coherent way. The only negative correlations related to *Practical work* and *Teacher explanation.* These seem to represent methods, which were perceived to have very contrasting impacts on enjoyment.

Figure 4.4.1 Correlations between teaching methods in terms of promoting pupils' enjoyment, perceptions of 5th grade teachers



The responses of 8th grade teachers with respect to enjoyment fell into two groups. One included discussion type teaching methods, and the other individualised methods. For 8th grade teachers, *Practical work* and *Reading textbook* were negatively correlated (see Figure 4.4.2).

Figure 4.4.2: Correlations between teaching methods in terms of promoting pupils' enjoyment, perceptions of 8th grade teachers



For 5th graders, teaching methods, which promoted enjoyment, were separated into two groups. One group consisted of *Practical work*, *Group discussion* and *Whole-class discussion,* and the other consisted of *Teacher explanation*, *Reading a textbook*, *Individual work* and *Individual help*. 5th graders appeared to have a much less integrated conception of the effects of different teaching methods compared to the perceptions of their teachers (see Figure 4.4.3 in appendix). 8th graders appeared to have similar perceptions to 5th graders in that teaching methods fell into two groups. One group consisted of *Whole-class discussion*, *Group discussion*, *Practical work* and *Using computer,* and the other consisted of *Reading textbook*, *Teacher explanation*, *Individual work* and *Individual help*. The degree of coherence in each group was much greater than that reported by 8th grade teachers (see Figure 4.4.4 in appendix).

Motivation

Figure 4.4.5: Correlations between teaching methods in terms of promoting pupils' motivation, perceptions of 5th grade teachers

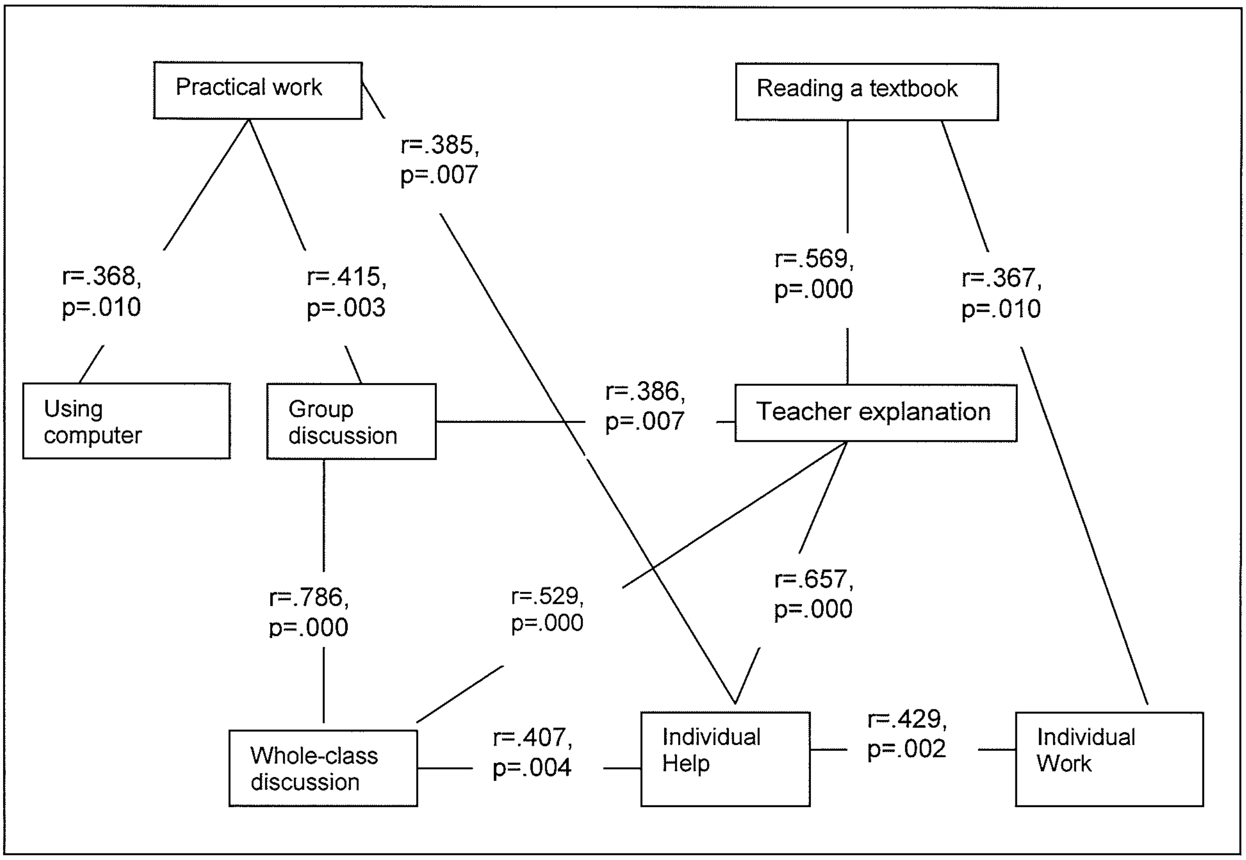


Figure 4.4.5 shows that there were significant moderate positive correlations between several teaching methods in the perceived promotion of motivation in the responses of 5th grade teachers. They appeared to have a relatively integrated perception of the effects of the teaching methods. There were positive relationships between *Teacher*

explanation and discussion style teaching methods and between *Individual help, Whole-class discussion*, and *Practical work.* This contrasts with the perceptions of 8th grade teachers, which are reported next.

8th grade teachers had a less integrated conception of teaching methods, in terms of promoting motivation. There was a significant moderate positive correlation between discussion style teaching methods. *Individual work* was perceived to relate with *Individual help* and *Teacher explanation. Teacher explanation* was perceived to relate with *Group discussion.* The two kinds of discussion style teaching methods were positively related. This is a considerably looser structure than that found in the responses of 5th grade teachers (see Figure 4.4.6 in appendix).

The relationships in the responses of 5th graders in terms of motivation are not dissimilar to those of their teachers, although they tended to fall into two main groupings. One group consisted of *Practical work*, *Group discussion* and *Whole-class discussion.* The other group consisted of *Teacher explanation*, *Reading a textbook*, *Individual work* and *Individual help.* They were linked by a correlation between *Teacher explanation* and *Whole-class discussion*. Overall, 5th graders appeared to have much less integrated conceptions of teaching methods, compared to the perceptions of their teachers (see Figure 4.4.7 in appendix). For 8th graders, teaching methods, which promoted their motivation, fell into two groups. One group consisted of *Practical work*, *Group discussion, Whole-class discussion* and *Using a computer*. The other group consisted of *Teacher explanation*, *Reading a textbook*, *Individual work* and *Individual help*. No significant correlations between the teaching methods belonging to each group in terms of promoting pupils' motivation was found (see Figure 4.4.8 in appendix).

A sense of security

For 5th grade teachers, teaching methods, which promoted pupils' sense of security, fell into two groups. One group consisted of the two kinds of discussion style teaching methods. The other group consisted of *Reading a textbook*, *Teacher explanation* and *Individual help*. (see Figure 4.4.9 in appendix). For 8th grade teachers, teaching methods, which promoted pupils' sense of security, fell into three groups. There were significant positive correlations between *Whole-class discussion*, *Practical work* and

Group discussion; Teacher explanation and *Reading a textbook;* and *Individual work* and *Individual help.* No significant relationships were found linking these groups (see Figure 4.4.10 in appendix).

For 5th graders, as for their teachers, teaching methods that promoted pupils' sense of security fell into three groups. *Practical work, Group discussion* and *Whole-class discussion; Reading a textbook* and *Teacher explanation;* and *Individual work and Individual help.* The first and the second groups were related through a correlation between *Whole-class discussion* and *Reading a textbook* (see Figure 4.4.11 in appendix). For 8th graders, teaching methods, which promoted pupils' sense of security, were divided into two clear groups. One group consisted of *Using a computer, Practical work, Whole-class discussion* and *Group discussion.* The other group consisted of *Reading a textbook, Teacher explanation* and *Individual help* (see Figure 4.4.12 in appendix).

A sense of progress

For 5th grade teachers, teaching methods, which promoted pupils' sense of progress, fell into two groups. There was a positive correlation between *Whole-class discussion* and *Group discussion*, and between *Reading a textbook* and *Teacher explanation. Individual help* was perceived to be related to *Whole-class discussion* in terms of promoting pupils' sense of progress (see Figure 4.4.13 in appendix). For 8th grade teachers, teaching methods that promoted pupils' sense of progress, were divided into three groups. There was a significant moderate positive correlation between *Practical work* and *Using a computer;* the two kinds of discussion style teaching methods; and between *Individual help, Teacher explanation* and *Individual work* (see Figure 4.4.14 in appendix).

For 5th graders, teaching methods, which promoted pupils' sense of progress, fell into three groups. There were significant moderate positive correlations between *Whole-class discussion, Group discussion* and *Practical work; Teacher explanation* and *Reading a textbook;* and *Individual work* and *Individual help.* The first and second groups were linked by a significant positive correlation between *Practical work* and *Reading a textbook* (see Figure 4.4.15 in appendix). For 8th graders, teaching methods, which promoted pupils' sense of progress, fell into two groups. One group consisted of

Whole-class discussion, *Group discussion*, *Practical work* and *Using a computer*. The other group consisted of *Individual help*, *Teacher explanation*, *Reading a textbook* and *Individual work*. However, some teaching methods were perceived to relate relatively strongly, others relatively weakly (see Figure 4.4.16 in appendix).

Deployment

Figure 4.4.17: Correlations between teaching methods in terms of the frequency of the deployment: 5th grade teachers

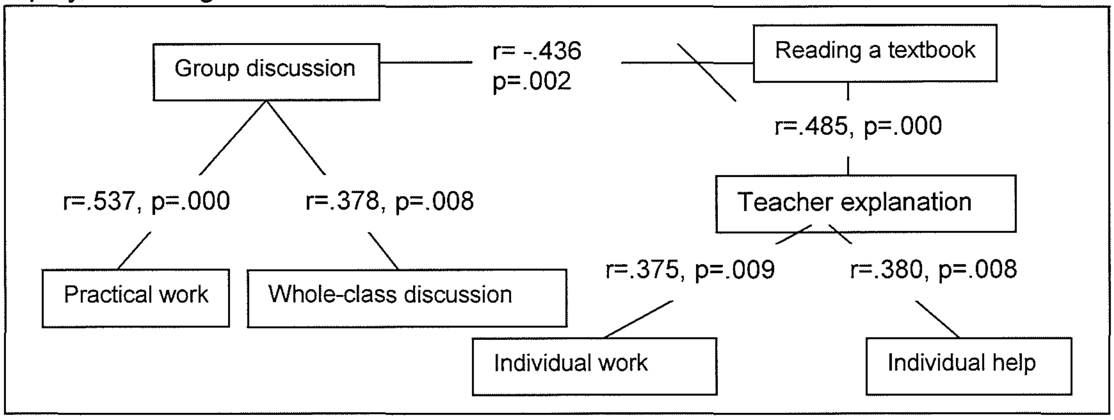


Figure 4.4.17 indicates that for 5th grade teachers, the teaching methods deployed in mathematics classes were divided into two groups. One group consisted of *Whole-class discussion, Group discussion* and *Practical work*. The other group consisted of *Reading a textbook*, *Teacher explanation*, *Individual work* and *Individual help*. There was a negative correlation between *Group discussion* and *Reading a textbook*, in terms of the frequency of their deployment in mathematics classes. For 8th grade teachers, the extent of deployment of *Group discussion* was correlated with *Practical work* and *Whole-class discussion*. There were no significant relationships between the other teaching methods (see Figure 4.4.18 in appendix).

For 5th graders, the perceived frequency of deployment of *Practical work* and *Group discussion*, and *Teacher explanation* and *Whole-class discussion* were moderately correlated in a positive direction (see Figure 4.4.19 in appendix). For 8th graders, the perceptions of deployment fell into two groups. *Practical work*, *Whole-class discussion* and *Group discussion* were moderately correlated in terms of the frequency of the deployment in a positive way, while *Teacher explanation* was perceived to relate to *Individual work* and *Individual help* (see Figure 4.4.20 in appendix).

Summary of 4.4

Taken together the evidence presented in this section suggests that different types of teaching methods are perceived to be linked in different ways in promoting different aspects of affect towards mathematics. In relation to pupil enjoyment there is a degree of consensus that practical activities, discussion and using computers are linked as are teacher explanation, reading textbooks, and individual work and help. In relation to motivation a more integrated picture emerges except for the 8th graders. The relationships pertaining to sense of security are the most divided with the individual aspects splitting from teacher explanation and reading a textbook. In relation to a sense of progress different patterns emerged with links across previous aspects. The deployment of teaching methods was closely divided into active participatory activities and those of teacher explanation, and teacher help for individuals and setting individual work. Motivation was, especially for 5th grade teachers, more integrated than the other aspects.

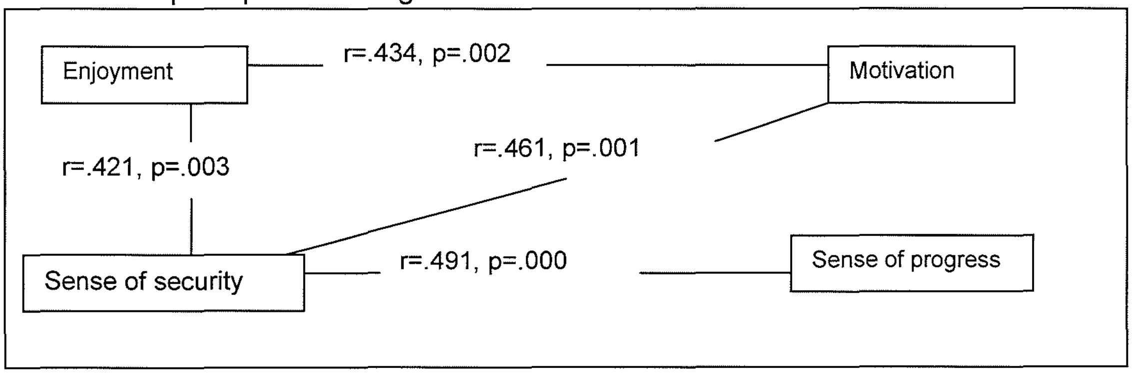
4.5: Perceived relationships of affect within each method

This section examines how pupils' enjoyment, motivation, sense of security and sense of progress are related within individual teaching methods. Pearson Product-moment correlations are used. The findings in 4.2 suggested that teaching methods were, overall, perceived to promote pupils' four attitudinal aspects differently. For instance, *Reading a textbook, Teacher explanation, Individual work* and *Individual help* were seen by both teachers and pupils to promote pupils' sense of security and sense of progress more than enjoyment and motivation. *Using a computer* was seen to promote pupils' enjoyment and motivation more than their sense of security and sense of progress. This section explores the relationships between teachers' and pupils' perceptions of pupils' affective attitudes to mathematics within each teaching method. This will indicate the extent to which participants believe that a particular teaching method can promote attitudinal aspects together, even if one aspect might be perceived to be less positively promoted than others. A lack of such relationships would indicate that the participants believed that the teaching method might promote one aspect but not others. The relationships between pupils' attitudinal aspects promoted by individual teaching methods and the deployment of particular teaching methods are also examined. The examination is conducted among the responses of 5th grade teachers, 8th grade teachers, 5th graders and 8th graders, separately.

Practical work

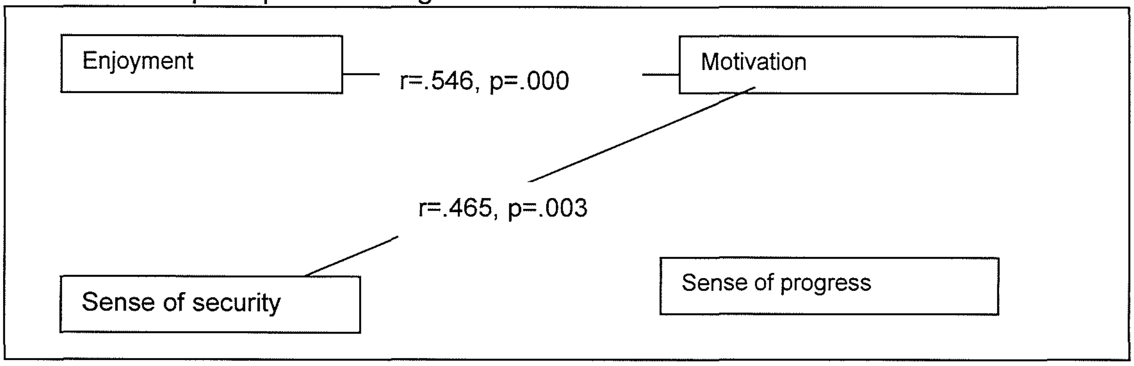
As illustrated in Figure 4.5.1, there were significant moderate positive correlations among the responses of 5th grade teachers to the effects of practical work on pupils' enjoyment and motivation, enjoyment and sense of security, motivation and sense of security, sense of security and sense of progress. Overall, *Practical work* was perceived as being relatively coherent in its effects on attitudes towards mathematics.

Figure 4.5.1 Relationships between attitudes to mathematics learning as promoted by *Practical work:* perceptions of 5th grade teachers



There were significant moderate positive correlations among the responses of 8th grade teachers between enjoyment and motivation, and motivation and sense of security as perceived to be promoted by *Practical work. Practical work* was perceived as promoting enjoyment, motivation and sense of security together but sense of progress was perceived as being unrelated to other facets (see Figure 4.5.2). This pattern shows less cohesion than that of the 5th grade teachers.

Figure 4.5.2 Relationships between attitudes to mathematics learning as promoted by *Practical work:* perceptions of 8th grade teachers

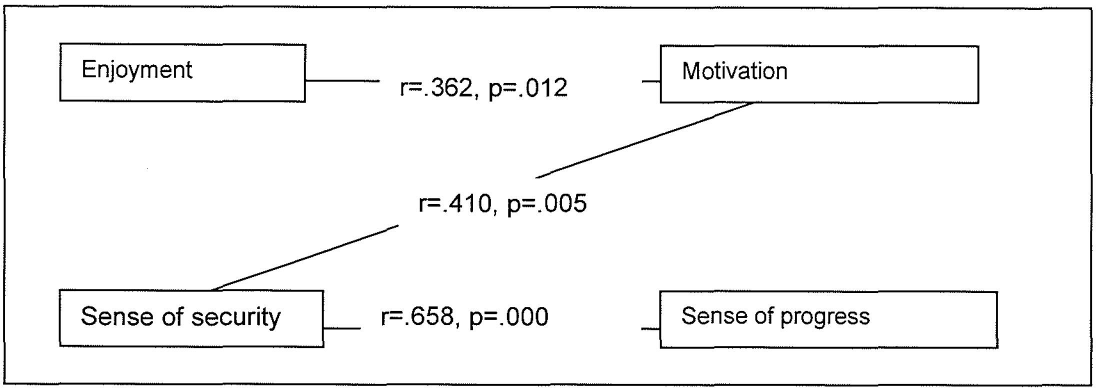


For the 5th graders, very positive correlations were observed between the effects of *Practical work* on all aspects of attitudes. For them, *Practical work* has a coherent positive effect on all attitudinal aspects (see Figure 4.5.3 in appendix). There were also significant moderate positive correlations among the responses of 8th graders to the effects on all four attitudinal aspects as promoted by *Practical work.* In many cases these were stronger than for the 5th graders (see Figure 4.5.4 in appendix). Overall, pupils perceived positive relationships between all the attitudinal measures as promoted by *Practical work.* This contrasted markedly with the relationships derived from the teachers responses. Teachers' responses demonstrated relationships between enjoyment, motivation and sense of security but not progress. This difference is important. In addition, there were fewer significant relationships between the teachers' responses.

Using a computer

Figure 4.5.5 shows that there were significant positive correlations among the responses of 5th grade teachers between the effects on pupils' motivation and sense of security and sense of security and sense of progress as promoted by *Using a computer.* A significant positive correlation was also found between enjoyment and motivation, although it was relatively weak. No significant relationships emerged between pupils' perceived enjoyment and sense of progress, and motivation and sense of progress as promoted by *Using a computer.*

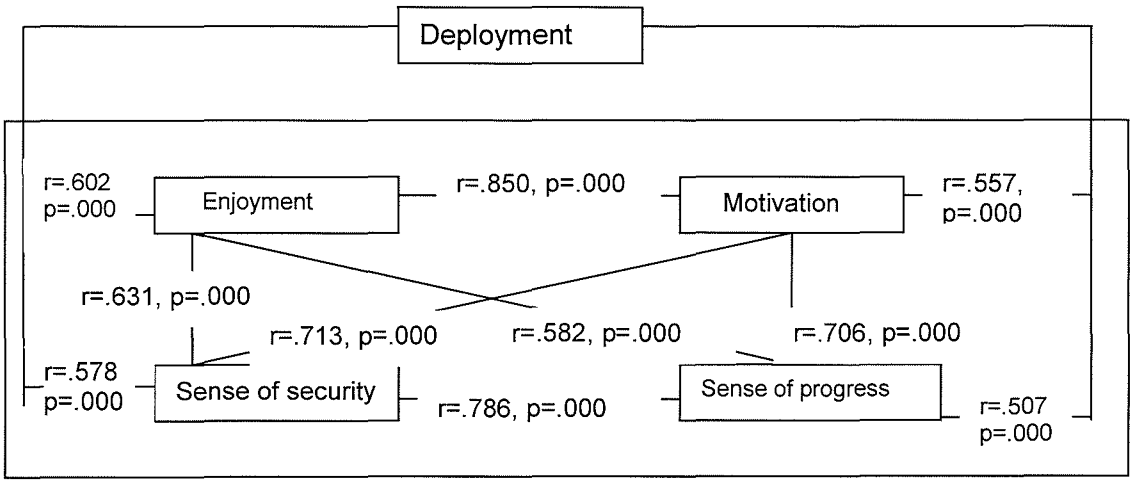
Figure 4.5.5: Relationships between attitudes to mathematics learning as promoted by *Using a computer*: perceptions of 5th grade teachers



The pattern emerging from the responses of 8th grade teachers was almost identical to that of the 5th grade teachers, except that there was a strong relationship between motivation and enjoyment (see Figure 4.5.6 in appendix). There were significant positive correlations among the responses of 5th graders between the effects on the four attitudinal aspects as promoted by *Using a computer*. For them, *Using a computer* positively impacted on their attitudinal responses in an integrated comprehensive way (see Figure 4.5.7 in appendix). A similar pattern of responses emerged for the 8th graders to the 5th graders (see Figure 4.5.8 in appendix). The impact of *Using a computer* on the various attitudinal aspects was integrated and coherent from the pupils perspective. From the teachers perspective the impact was less coherent.

Reading a textbook

Figure 4.5.9: Relationships between attitudes to mathematics learning as promoted by *Reading a textbook*: perceptions of 5th grade teachers



Both teachers and pupils perceived that the effects on all attitudinal aspects promoted by *Reading a textbook* were moderately correlated in a positive direction. For teachers of both age groups and 8th graders, the frequency of deployment of *Reading a textbook* was positively correlated with the effects on pupils' four attitudinal aspects. For 5th graders, the frequency of deployment of *Reading a textbook* was positively correlated with enjoyment and sense of security, but not with motivation or sense of progress. Overall, there was greater consensus between pupils and teachers in relation to *Reading a textbook* than *Practical work* or *Using a computer* (see Figure 4.5.9 above; Figure 4.5.10; Figure 4.5.11; Figure 4.5.12 in Appendix).

Teacher explanation

For 5th grade teachers, the perceived effects of pupils' attitudinal aspects promoted by *Teacher explanation* were, overall, significantly moderately correlated in a positive direction, while pupils' motivation and sense of progress as promoted by *Teacher explanation* were not correlated (see Figure 4.5.13 in appendix). There were significant moderate positive correlations among the responses of 8th grade teachers between enjoyment and motivation, enjoyment and sense of security, motivation and sense of security and motivation and sense of progress as promoted by *Teacher explanation*. For 8th grade teachers, pupils' enjoyment and sense of progress, and sense of security and sense of progress were not correlated (see Figure 4.5.14 in appendix).

For 5th graders, the impact of *Teacher explanation* on their attitudes was more cohesive than perceived by their teachers. The correlations were generally higher and there were more of them (see Figure 4.5.15 in appendix). The pattern of relationships identified for 8th graders was similar to 5th graders. There were significant moderate positive correlations among the responses of both 5th graders and 8th graders between the perceived effects on their four attitudinal aspects promoted by *Teacher explanation.* The correlations were similar between age groups (see Figure 4.5.16 in appendix). Pupils at both grades perceived *Teacher explanation* as having a more coherent positive affect on their attitudes towards learning mathematics than their teachers.

Individual work

Figure 4.5.17: Relationships between attitudes to mathematics learning as promoted by *Individual work*: perceptions of 5th grade teachers

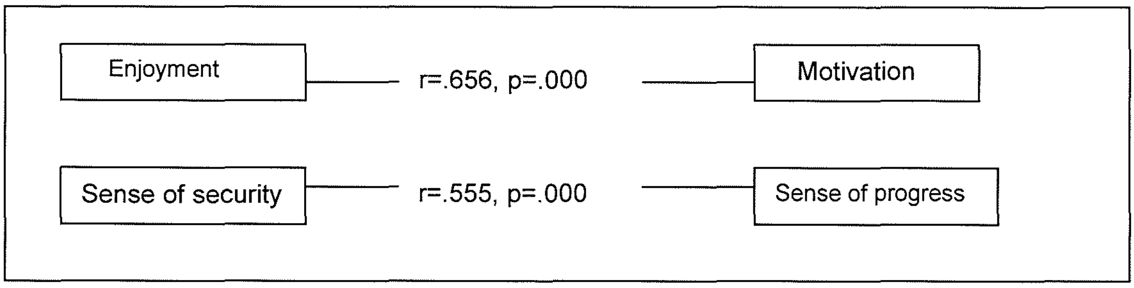
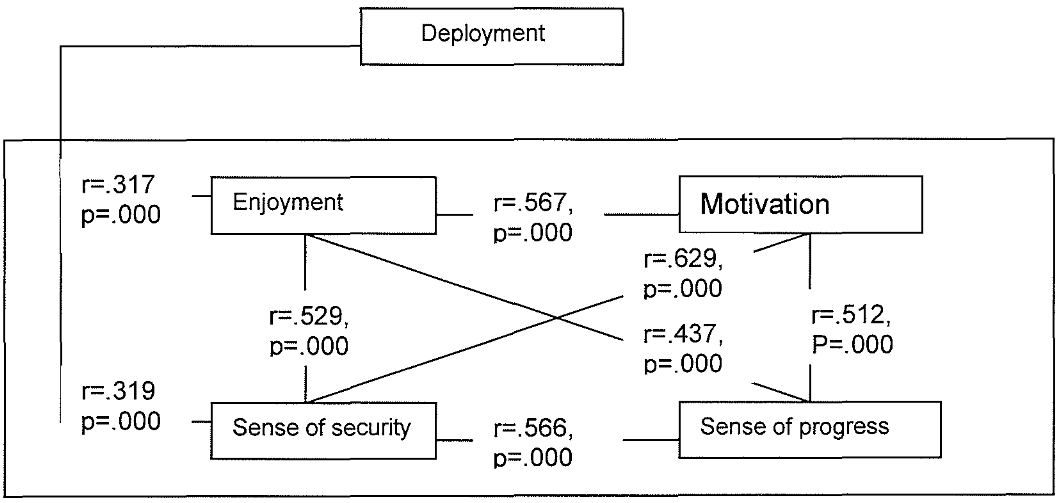


Figure 4.5.17 shows that compared with the previous teaching methods examined the relative lack of relationships for *Individual work* is marked. The only positive relationships for 5th grade teachers were between enjoyment and motivation, and sense of security and progress. For 8th grade teachers, pupils' enjoyment and motivation, and motivation and sense of progress promoted by *Individual work* were correlated. In contrast with the relationships outlined earlier the impact of *Individual work* on pupils attitudes was not seen as integrated (see Figure 4.5.18 in appendix). For the pupils at 5th grade, there were significant moderate positive correlations between the effects on the four attitudinal aspects as promoted by *Individual work*. These were also related to the extents that the method were perceived to be deployed.

Figure 4.5.19: Relationships between attitudes to mathematics learning as promoted by *Individual work*: perceptions of 5th graders



The findings for 8th graders were similar to those for 5th graders with moderately positive relationships between the four attitudinal aspects. These were not however related to the extent of deployment of the method (see Figure 4.3.20 in appendix). For pupils, the effects on the four attitudinal aspects as promoted by *Individual work* were moderately correlated in a positive direction. However, for teachers of both age groups, pupils' attitudinal aspects promoted by *Individual work* were sparsely correlated. This again indicates discrepancies between the perceptions of pupils and teachers.

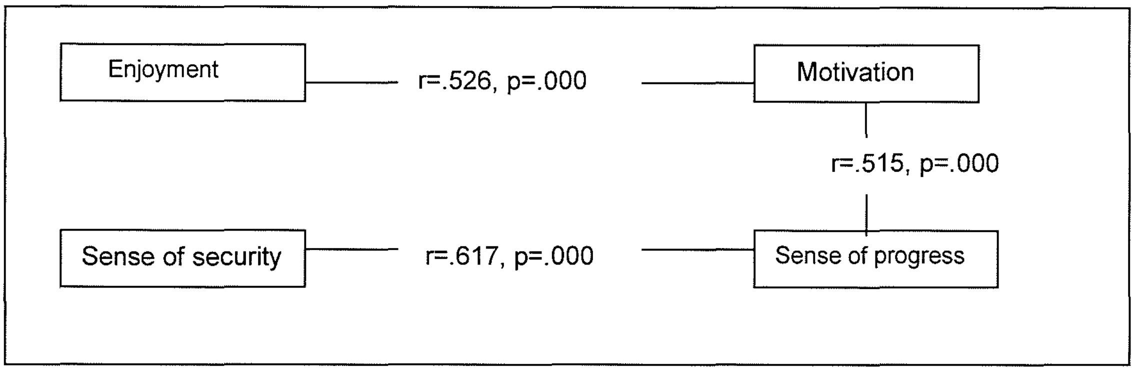
Individual help

For 5th grade teachers, there were significant moderate positive correlations among the responses made regarding the effects on the four attitudinal aspects as promoted by *Individual help* (see Figure 4.5.21 in appendix). In comparison with the 5th grade teachers, for 8th grade teachers, there were fewer and lower correlations in relation to the impact of *Individual help (*see Figure 4.5.22 in appendix). There were significant moderate positive correlations among the responses of 5th graders between the effects on the four attitudinal aspects promoted by *Individual help.* These were not related to perceived deployment of *Individual help* (see Figure 4.5.23 in appendix). The pattern for 8th graders mirrored that of the 5th graders (see Figure 4.5.24 in appendix). *Individual help* was seen to promote positive attitudes towards learning mathematics by all respondent, although for 8th grade teachers, pupils' enjoyment and sense of progress and motivation and sense of progress were not related.

Whole-class discussion

There was a strong significant positive correlation between enjoyment and motivation and moderate correlations among the responses of 5th grade teachers related to the effects on the four attitudinal aspects as promoted by *Whole-class discussion.* There were also significant correlations between the frequency of deployment of this teaching method and pupils' perceived enjoyment, and motivation (see Figure 4.5.25 in appendix). The pattern of relationships for 8th grade teachers is in stark contrast to that of 5th grade teachers (see Figure 4.5.26). There were significant moderate positive correlations between pupils' enjoyment and motivation, motivation and sense of progress, and sense of security and sense of progress as promoted by *Whole-class* *discussion* but not between the other aspects. This may indicate that the way that *Whole-class discussion* is conducted in 5th and 8th grade is different.

Figure 4.5.26: Relationships between attitudes to mathematics learning as promoted by *Whole-class discussion*: perceptions of 8th grade teachers

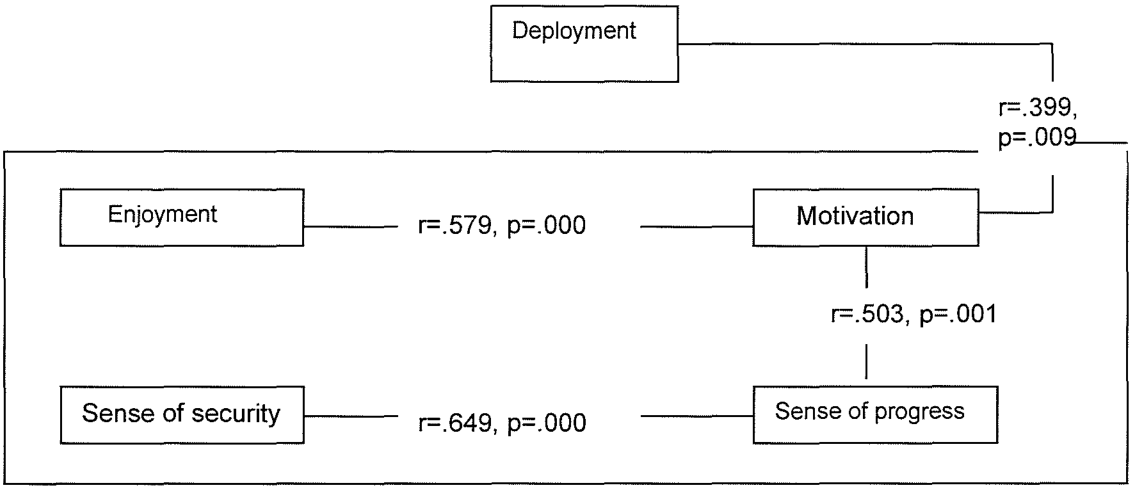


There were significant moderate positive correlations among the responses of pupils of both age groups between the perceived effects on pupils' four attitudinal aspects promoted by *Whole-class discussion.* 5th graders' perceived frequency of deployment of this teaching method was positively related with pupils' enjoyment, and sense of progress. Both teachers and pupils of 5th grade perceived that the frequency of deployment of this teaching method was positively related with pupils' enjoyment. There were also the correlations between 8th graders' perceived frequency of deployment of this teaching method and pupils' enjoyment. This contrasts markedly with the responses of the 8th grade teachers where few relationships emerged (see Figure 4.5.27 and Figure 4.5.28 in appendix).

Group discussion

There were significant to strong moderate positive correlations among the responses of 5th grade teachers regarding the effects on pupils' four attitudinal aspects as promoted by *Group discussion* indicating a coherence in their perceived effects (see Figure 4.5.29 in appendix). In contrast, 8th grade teachers exhibited less coherence in their responses, as Figure 4.5.30 shows. There were only significant moderate positive correlations between pupils' enjoyment and motivation, motivation and sense of progress, sense of security and sense of progress as promoted by *Group discussion*. However, the frequency of deployment of *Group discussion* and pupils' motivation were correlated.

Figure 4.5.30: Relationships between attitudes to mathematics learning as promoted by *Group discussion*: perceptions of 8th grade teachers



For 5th graders, there were significant positive correlations between the perceived effects on pupils' four attitudinal aspects promoted by *Group discussion* and the frequency of deployment of *Group discussion* and pupils' enjoyment (see Figure 4.5.31 in appendix). The pattern for 8th graders was similar to 5th graders although there were no significant relationships with perceived deployment (see Figure 4.5.32 in appendix). For pupils of both age groups and 5th grade teachers, the perceived effects on the four attitudinal aspects promoted by *Group discussion* were correlated. However, for 8th grade teachers this was not the case. This pattern mirrors that for *Whole-class discussion*. The way discussion is perceived is clearly different for 8th grade teachers to all pupils and 5th grade teachers.

Summary of 4.5

Overall, the findings in this section demonstrate that for pupils of both age groups, the four attitudinal aspects promoted by individual teaching methods were more clearly correlated, showing a coherence in their perceptions of the affects. Although for teachers of both age groups, the four attitudinal aspects as promoted by some teaching methods were correlated, they did not perceive such close relationships as their pupils. Teachers were more likely to perceive pupils' affective attitudes divided into enjoyment and motivation as one group and sense of security and sense of progress as another. This tendency was greater for the 8^{th} grade teachers. Frequencies of the deployment of the teaching methods were not significantly correlated with perceptions of pupils' affective attitudes in most cases.

Factor analysis

To further explore the relationships between teaching methods and perceived effects on pupils a factor analysis was undertaken. The findings from this, taking account of the different samples were inconclusive, although they tended to indicate that relationships within teaching methods were key.

4.6: Summary of findings of Chapter 4

Overall, teaching methods seem to be perceived in relation to membership of two main categories. One category consists of *Practical work, Using a computer*, *Whole-class discussion* and *Group discussion,* those which often involve groups of pupils working together. The other group consists of *Teacher explanation*, *Reading a textbook*, *Individual work* and *Individual help*, where pupils' cognitive activities are individual. Some of the teaching methods in these different categories are perceived by teachers as opposing each other in terms of promoting pupils' affective attitudes towards mathematics learning. These distinctions appear more strongly at 8^{th} grade than 5^{th} grade. Teachers and pupils at 5^{th} grade seem to take a more integrated view of the way affective attitudes towards mathematics, especially enjoyment and motivation, are promoted by different teaching methods.

Teachers of both age groups reported that *Teacher explanation*, *Individual work*, *Individual help* and *Reading a textbook* were frequently deployed in mathematics classes. The most frequently deployed methods were well matched with pupils' preference at 8^{th} grade, but less so at 5^{th} grade. 5^{th} graders were more likely to favour *Practical work.* They tended to view individualised teaching methods as having less positive affects on their attitudes. 5^{th} graders overall perceived that *Individual help* was deployed in their classes much less than their teachers perceived.

Generally teachers appeared to deploy teaching methods, which they perceived, were beneficial to promote pupils' sense of security and sense of progress. Other teaching methods, which were perceived as not beneficial in promoting pupils' sense of security and sense of progress but as promoting enjoyment and motivation, were less frequently deployed at both grade levels.

Analysis of teachers' responses suggested that most of the teaching methods were not believed by teachers to promote pupils' four affective aspects together. There was a tendency for them to perceive that enjoyment and motivation were in one category while sense of security and sense of progress were in another. In contrast, pupils tended to perceive that all of the teaching methods promoted pupils' four affective aspects together.

Pupils' perceptions of the frequency of the deployment of teaching methods and the extent to which their affective attitudes were promoted by these teaching methods were lower than their teachers. There were also relatively large individual differences. Pupils as a whole seem to have rather different perceptions of the extent of deployment of *Teacher explanation* and individualised work, requiring individual cognitive activities, even though teachers seem to intend to deploy these teaching methods to a similar extent. There was a wide distribution in pupils' perceived frequency of individual help at both grades. This may indicate that teachers give pupils individual help to different extents.

The frequency of deployment of *Reading a textbook* and discussion-style teaching methods seemed to affect teachers' and pupils' perceptions of the extent to which these teaching methods promoted pupils' affective attitudes towards mathematics learning. This also applied to the deployment of *Individual work* for 5th graders. For these methods, more frequent perceived deployment led to more positive perceptions of the effects on attitudes.

To conclude, there seem to be substantive differences in the perceptions of pupils and teachers at and between grades in the extent to which different teaching methods are seen to be deployed and their perceived impact on affective attitudes towards learning mathematics.

CHAPTER 5: COMPARISON OF TEACHERS' AND PUPILS' PERCEPTIONS OF THE FACTORS CONTRIBUTING TO PUPILS' AFFECTIVE ATTITUDES TOWARDS MATHEMATICS LEARNING PROMOBTED BY DIFFERENT TEACHING METHODS

This chapter compares teachers' and pupils' perceptions of the factors contributing to pupils' affective attitudes towards mathematics learning promoted by different teaching methods in mathematics classes. Open questions were included in the questionnaires for teachers of both age groups and for 8th graders. Such questions were not included in the questionnaire for 5th graders because of their difficulty in expressing themselves clearly in writing, as explained in Chapter 3. The same questions were adopted for teachers of both age groups and 8th graders. The questions were as follows:

1. Why do you think particular teaching methods promote pupils' enjoyment in learning mathematics?
2. Why do you think particular teaching methods promote pupils' motivation to learn mathematics?
3. Why do you think particular teaching methods promote pupils' sense of security in learning mathematics?
4. Why do you think particular teaching methods promote pupils' sense of progress in learning mathematics?

Forty-eight 5th grade teachers, forty-two 8th grade teachers and 2156 8th graders took part in the questionnaire survey. The responses of all teachers' open questions were analysed. Approximately 470 8th graders' responses to the open questions were randomly selected and analysed, because it was impractical to analyse all of them. The responses were analysed using, Cooper et al.'s (1993) seven-stage process.

1. to read a random sample of transcripts;
2. to identify the points of similarity and difference among these transcripts in relation to the research questions;
3. to generate theories, on the basis of the second stage and describe emergent answers to research questions;
4. to test these theories against a new set of transcripts;
5. to test the new theories against transcripts already dealt with;
6. to carry all existing theories forward to new transcripts;

7. to repeat the above processes until all data have been examined and all theories tested against all data.

Quotations from the raw data are presented in Appendix chapter 5.

5.1: Teachers' and pupils' perceptions of the factors contributing to pupils' enjoyment in mathematics learning

Thirty-five 5th grade teachers (73%) and thirty-one 8th grade teachers (74%) responded to the question regarding enjoyment. The responses of 466 8th graders to this question were analysed. Teachers of both age groups appeared to have similar perceptions, and the responses of the 8th graders supported the teachers' views to some extent.

Firstly, nine 5th grade teachers (27% of the respondents), and ten 8th grade teachers (32% of the respondents) considered that the extent to which pupils were actively involved in mathematics learning would contribute to their enjoyment in learning. Some mentioned that active rather than passive learning would be enjoyable (ap.5.1.1.8th T). A 5th grade teacher judged that activity-based teaching methods must be more enjoyable than teacher explanation, because pupils could take an active part in learning (ap.5.1.2.5th T). Some teachers from both age groups suggested that encouraging pupils' autonomy in mathematics learning was important to promote enjoyment (ap.5.1.3.5th T). Teachers seemed to think that teacher-led lessons were not enjoyable (ap.5.1.4.5th T), while practical work, experiments (ap.5.1.5.8th T) and whole-class discussion (ap.5.1.6.8th T), which were more pupil-centred, were enjoyable. In short, these teachers believed that pupils' involvement, facilitated by active, positive and autonomous learning, contributed to pupils' enjoyment of mathematics learning. In support of this, eleven 8th graders (2%) stated that they enjoyed learning mathematics when they felt involved. However, this factor was considerably less emphasised as contributing to enjoyment by 8th graders than by their teachers. Some 8th graders mentioned that the ease with which they could be involved in activities would allow enjoyment in learning mathematics (ap.5.1.7.8th P); others emphasised self-reliance in mathematics learning as the factor contributing to enjoyment (ap.5.1.8.8th P).

Secondly, eight 5th grade teachers (23%) and six 8th grade teachers (20%) pointed out that promoting pupils' interest, curiosity and amusement could be linked to enjoyment in mathematics learning. Computer programmes (ap.5.1.9. 5th T), practical work (ap.5.1.10.5th T) and new experiences in mathematics lessons (ap.5.1.11.8th T) were perceived to promote pupils' enjoyment in mathematics learning by inspiring their interest and curiosity.

Some 5th grade teachers stressed 'amusement', for instance game-like elements as contributing to pupils' enjoyment in mathematics learning (ap.5.1.12.5th T). In contrast, no 8th grade teachers mentioned this. However, 142 out of 466 8th graders (30%) stated that they enjoyed learning mathematics when their interest and curiosity were satisfied and they had fun. The teaching methods which 8th graders pointed out as promoting enjoyment in mathematics learning by facilitating their interest varied between practical activities (ap.5.1.13.8th P), doing exercises (ap.5.1.14.8th P) and listening to teachers' explanations (ap.5.1.15.8th P). Many 8th graders were curious about learning mathematics by teaching methods which had not been adopted in their classes so far, such as practical activities (ap.5.1.16.8th P) and using a computer (ap.5.1.17.8th P). Some students emphasised that fun-like elements in teaching methods helped them enjoy learning mathematics. Many of them thought that using a computer in mathematics classes must be fun (ap.5.1.18.8th P). They expected that learning mathematics through computer programmes (ap.5.1.19.8th P) and practical activities (ap.5.1.20.8th P) would provide pupils with opportunities to escape from the negative feelings they might have formed in mathematics classes.

Thirdly, four 5th grade teachers (11%) and five 8th grade teachers (16%) believed that catering for pupils' individuality could promote their enjoyment in mathematics learning. This included allowing for individual differences in learning pace, learning style (ap.5.1.21.8th T), current levels of attainment (ap.5.1.22.8th T), and desire for individual support (ap.5.1.23.5th T; ap.5.1.24.8th T). One 5th grade teacher mentioned that pupils would feel valued when learning mathematics in a way in which their individuality was considered, and that feeling valued would be linked to enjoyment (ap.5.1.25. 5th T). Seventeen 8th graders (4%) pointed out that learning mathematics in ways which take account of individual differences would promote their enjoyment. Most thought that individual teaching methods could satisfy individual needs by being related to current attainment (ap.5.1.26.8th P) and learning pace (ap.5.1.27.8th P). Some students thought that undertaking practical activities and taking part in discussion were beneficial to meet individual interests (ap.5.1.28.8th P).

Fourthly, four 5th grade teachers (11%) and six 8th grade teachers (20%) pointed out that promoting pupils' understanding of the curriculum would promote pupils' enjoyment of mathematics classes. The teaching methods were considered to support this varied, and included practical activities with observable materials (ap.5.1.29.8th T), clear teacher explanation (ap.5.1.30.8th T) with replication according to pupils' needs (ap.5.1.31.8th T), and group discussion providing opportunities for peer tutoring (ap.5.1.32.8th T). Approximately three out of ten, 136 8th graders (29%) pointed out that their enjoyment of mathematics learning could be promoted by teaching methods which promoted their understanding of the curriculum. However, the teaching methods which 8th graders perceived as promoting enjoyment of mathematics learning by improving their understanding of the curriculum content varied across all of the teaching methods explored in this study. Some students commented that practical activities promoted understanding of the curriculum and helped maintain the lesson content in long-term memory (ap.5.1.33.8th P). Learning 'shape' through using a computer appealed to the visual sense (ap.5.1.34.8th P). Reading a textbook provided pupils with schemata for what they were learning (ap.5.1.35.8th P). Pupils also developed understanding of the curriculum by listening to a clearly presented teacher's explanation (ap.5.1.36.8th P). Doing exercises individually helps pupils to construct thinking abilities through trial and error independently (ap.5.1.37.8th P). Pupils also reported clarifying uncertain points by receiving individual support from the teacher (ap.5.1.38.8th P). Discussion in a class (ap.5.1.39.8th P) and learning mathematics with peers (ap.5.1.40.8th P) were also reported as developing understanding.

Fifthly, six 5th grade teachers (17%) and two 8th grade teachers (6%) wrote that pupils would come to enjoy learning mathematics by developing mathematical thinking abilities. Some teachers recommended the adoption of practical activities to promote pupils' enjoyment of mathematics learning by activating children's mathematical thinking (ap.5.1.41.5th T), while others believed that sharing ideas with their peers in a class or a group must be enjoyable (ap.5.1.42.5th T; ap.5.1.43.8th T). Twenty-three 8th graders (5%) wrote that developing mathematical thinking abilities was linked to enjoyment in mathematics learning. Some students thought that practical work was enjoyable because they could develop their thinking through observation (ap.5.1.44.8th P). One student mentioned that she enjoyed finding various solutions with many friends through whole-class discussion (ap.5.1.45.8th P), while another mentioned that group discussion was more enjoyable than whole-class discussion because she could put forward her own views (ap.5.1.46.8th P).

Some issues were raised by 8th graders, but not their teachers. Firstly, fifty-nine students (13%) mentioned that interaction with friends in mathematics classes was enjoyable, and maintaining interactions was perceived to contribute more to their enjoyment of mathematics learning than satisfying their own individuality. These interactions gave opportunities to communicate with peers (ap.5.1.47.8th P), increase mutual trust (ap.5.1.48.8th P), and secure a sense of attachment to class members (ap.5.1.49.8th P). Only one 8th grade teacher mentioned that interactions in mathematics classes could promote pupils' enjoyment of mathematics learning and he did not relate it to enjoyment in mathematics learning. He stressed that positive involvement was also a key element in promoting pupils' enjoyment (ap.5.1.50.8th P). Eighteen students (4%) stated that interaction with the teacher could promote their enjoyment (ap.5.1.51.8th P), while twelve students (3%) stated that enhancing concentration promoted their enjoyment (ap.5.1.52.8th P). Many students used the word 'concentration'. This seems to be different from the 'involvement', discussed above.

Ten students (2%) gave other reasons. Four students stated that teaching methods which provided students with goals in their mathematics classes, promoted enjoyment (ap.5.1.53.8th P). Five mentioned that learning mathematics by familiar methods was more enjoyable than learning mathematics by unfamiliar methods (ap.5.1.54.8th P), although many more pupils suggested that learning mathematics by new methods was enjoyable, as described earlier. One student said that competition with peers promoted their enjoyment (ap.5.1.55.8th P).

Four 5th grade teachers (11%) and two 8th grade teacher (6%) suggested multiple factors as contributing to promoting pupils' enjoyment of mathematics learning. Two 5th grade teachers and an 8th grade teacher suggested that adopting several teaching methods such as a combination of whole-class sessions and individual sessions (ap.5.1.56.5th T), or practical activities and using a computer (ap.5.1.57.8th T) promoted pupils' understanding of the curriculum, developed mathematical thinking abilities, and in turn, promoted pupils' enjoyment. One 5th grade teacher thought that the combination of practical work, to encourage pupils' positive involvement in activities and group discussion to promote understanding would promote enjoyment (ap.5.1.58.5th T). Other teachers commented that a particular teaching method could combine two elements together; for instance, practical work was perceived to promote pupils' understanding of the curriculum while also encouraging their positive involvement in learning (ap.5.1.59.5th T). Another suggested that it promoted pupils' interest and understanding of the curriculum together (ap.5.1.60.8th T).

Thirty-eight students (8%) gave multiple reasons. Of these, 12 pointed out that maintaining interest and developing understanding of the curriculum together contributed to promotion of their enjoyment. Four students stated that receiving support from the teacher and the promotion of their understanding of the curriculum were important, while another 4 students stated that interaction with peers and promotion of their understanding of the curriculum together promoted their enjoyment. Three students stated that promotion of their interest and concentration on learning helped them enjoy mathematics. Fifteen students gave other combinations of reasons. Some indicated that they needed several learning styles to promote their enjoyment in mathematics learning; others focused on a particular teaching method; this finding reflected the perceptions of the teachers.

Table 5.1: Percentages of teachers of both age groups and 8th graders who referred to different aspects of promoting pupils' enjoyment in learning mathematics

	5th grade teachers	8th grade teachers	8th graders
Encouraging pupils' involvement in mathematics learning	N=9 (27%)	N=10 (32%)	N=11 (2%)
Promoting pupils' interest in mathematics learning	N=8 (23%)	N=6 (20%)	N=142 (30%)
Meeting pupils' individual needs in mathematics learning	N=4 (11%)	N=5 (16%)	N=17 (4%)
Promoting pupils' understanding of the curriculum	N=4 (11%)	N=6 (20%)	N=136 (29%)
Developing pupils' mathematical thinking abilities	N=6 (17%)	N=2 (6%)	N=23 (5%)
Interaction with peers	--------------------	--------------------	N=59 (13%)
Interaction with the teacher	--------------------	--------------------	N=18 (4%)
Concentration	--------------------	--------------------	N=12 (3%)
Other reasons	--------------------	--------------------	N=10 (2%)
Multiple reasons	N=4 (11%)	N=2 (6%)	N=38 (8%)
Total	N=35 (100%)	N=31 (100%)	N=466 (100%)

Table 5.1 shows that teachers of both age groups believed that encouraging pupils' involvement in mathematics learning and promoting their interest in it were the main factors which contributed to promoting pupils' enjoyment. 8th graders also believed that promoting their interest in mathematics learning could promote their enjoyment, but the percentage of students indicating that promoting pupils' interest in learning mathematics promoted enjoyment was smaller than the percentage of teachers. Developing pupils' mathematical thinking abilities was perceived as a factor contributing to promoting pupils' enjoyment more at 5th grade than at 8th grade, while promoting pupils' understanding of the curriculum was perceived as a factor contributing to promoting pupils' enjoyment more at 8th grade than at 5th grade. 8th graders in particular emphasised that promoting understanding of the curriculum was important in enabling them to enjoy learning. More than one in ten students indicated that peer interaction promoted their enjoyment, while only one teacher mentioned this. Teachers seemed to think that meeting pupils' individual needs was more important than peer interaction in making lessons enjoyable. Some 8th graders indicated that interaction with the teacher and concentration contributed to promoting their enjoyment. Few 8th graders mentioned factors such as competition, learning goals and good learning experiences. Participants pointing out multiple factors were few.

5.2: Teachers' and pupils' perceptions of the factors contributing to pupils' motivation to learn mathematics

Thirty-two 5th grade teachers (67%) and thirty 8th grade teachers (72%) responded to the question regarding the factors contributing to promoting pupils' motivation to learn mathematics. Responses of 434 8th graders on this question were analysed. Many of the factors raised were common to teachers of both grades and overlapped with those mentioned as providing the promotion of enjoyment. Firstly, eight out of thirty-two 5th grade teachers (25%) and seven out of thirty 8th grade teachers (23%) mentioned that encouraging pupils' involvement in mathematics learning by securing pupils' active and autonomous learning (ap.5.2.1.5th T) would promote pupils' motivation to learn mathematics. Teachers perceived that pupils' active and autonomous learning could prevent learners from feeling forced to learn, and in turn, promote pupils' motivation to learn mathematics (ap.5.2.2. 8th T). Thirty 8th graders (7%) answered that positive involvement in activities would promote their motivation to learn mathematics. Some of them mentioned that ease of involvement with the activity motivated pupils to learn mathematics (ap.5.2.3.8th P), while others mentioned that self-reliance in mathematics learning would promote motivation (ap.5.2.4.8th P).

Secondly, one quarter of teachers of both age groups (seven teachers from each age group; 22% at 5th grade and 23% at 8th grade) considered that inspiring pupils' interest in mathematics learning would promote motivation. Some teachers of both age groups thought that activities-based teaching methods, such as practical work and using a computer, would promote pupils' interest, amusement and curiosity better than teaching methods traditionally adopted such as teacher explanation and doing exercises (ap.5.2.5.5th T; ap.5.2.6.8th T). Approximately one quarter of 8th graders (N=116, 27%) referred to this (ap.5.2.7.8th P). The teaching methods they suggested as promoting pupils' motivation to learn mathematics by inspiring interest were diverse; practical work (ap.5.2.8.8th P), using a computer (ap.5.2.9.8th P) and doing exercises (ap.5.2.10.8th P). Some students indicated that their curiosity about new teaching methods could promote their motivation (ap.5.2.11.8th P).

Thirdly, six teachers from both age groups (19% of the 5th grade and 20% of the 8th grade groups) wrote that catering for pupils' individual needs in mathematics learning promoted pupils' motivation (ap.5.2.12.8th T). Teachers wrote that teaching methods which avoided monotonous style lessons motivated pupils to learn mathematics (ap.5.2.13.5th T). Teachers believed that teaching methods catering for individual current attainment (ap.5.2.14.5th T; ap.5.2.15.8th T), individual preferences of learning style (ap.5.2.16.5th T), and individual interest in learning (ap.5.2.17.5th T) should be considered, in order to motivate pupils to learn mathematics. Seventeen 8th graders (4%) also pointed out this aspect. One 8th grader wrote that he felt able to try hard in individual work because of its flexibility of pace and or receiving help according to his needs (ap.5.2.18.8th P).

Fourthly, three 5th grade teachers (9%) and five 8th grade teachers (18%) considered that promoting pupils' understanding of the curriculum would enhance pupils' motivation to learn mathematics (ap.5.2.19.5th T; ap.5.2.20.8th T). Teachers thought that pupils' understanding of the curriculum was promoted through learning with peers (ap.5.2.21.5th T), working with tangible materials (ap.5.2.22.5th T) and receiving individual help from the teacher (ap.5.2.23.8th T). As a result of these, pupils' motivation to learn mathematics would be enhanced. A quarter of 8^{th} graders (N=108, 25%) thought that increasing understanding of the curriculum would promote their motivation to learn mathematics. Improvement in understanding of the curriculum made them feel happier and motivated them to want to try harder (ap.5.2.24.8^{th} P). The teaching methods which 8^{th} graders identified as promoting their motivation to learn mathematics by improving their understanding of the curriculum were diverse; teachers' help in individual sessions (ap.5.2.25.8^{th} P), listening to teacher explanations (ap.5.2.26.8^{th} P) and reading a textbook (ap.5.2.27.8^{th} P). They had experience of increased understanding of the curriculum with a subsequent impact on their motivation when these methods were used.

Fifthly, two 5^{th} grade teachers (6%) and three 8^{th} grade teachers (10%) indicated that developing pupils' mathematical thinking abilities would promote pupils' motivation. The teachers perceived that knowing others' views and examining their justifications and the suitability of each solution through discussion (ap.5.2.28.5^{th} T); trial and error learning through practical work (ap.5.2.29.8^{th} T); and appealing to the visual sense by using a computer (ap.5.2.30.8^{th} T) could promote pupils' mathematical thinking abilities and enhance pupils' motivation. Thirteen 8^{th} graders (3%) suggested that developing their mathematical thinking abilities would promote their motivation to learn mathematics. The most frequently mentioned teaching method was group discussion (ap.5.2.31.8^{th} P).

There were some factors which were raised only by the students. Some 8^{th} graders pointed out that interaction with peers promoted their motivation. These pupils emphasised actual interaction itself more than developing their mathematical thinking abilities through interaction. 26 students (6%) expressed this view. Some mentioned that teaching each other in a group motivated them to learn mathematics (ap.5.2.32.8^{th} P). Others said that knowing everyone in a group promoted their motivation (ap.5.2.33.8^{th} P). Others indicated that learning mathematics with peers who had similar mathematics marks encouraged them to try harder (ap.5.2.34.8^{th} P). Fifty-six 8^{th} graders (13%) stated that interaction with the teacher promoted their motivation. These students emphasised the interaction itself rather than the cognitive development obtained through teacher-pupil interaction. They mentioned that receiving help (ap.5.2.35.8^{th} P) and praise (ap.5.2.36.8^{th} P) from the teacher, irrespective of class organisation style, made them persevere on the task. Forty-four 8^{th} graders (10%) indicated that teaching methods, which let them concentrate on tasks or activities improved their motivation. Many students thought that they were motivated to learn mathematics individually because they could concentrate better on the tasks in an individual session rather than a whole-class (ap.5.2.37.8th P) or group session (ap.5.2.38.8th P). Sixteen 8th graders (3%) suggested other factors as promoting their motivation. Of these, 13 mentioned competition in whole-class discussion (ap.5.2.39.8th P) or group learning (ap.5.2.40.8th P). One student said that teaching methods which set out the goals of learning clearly, promoted his motivation. Two students indicated that they tried harder to learn mathematics with methods that they were familiar with. Six 5th grade teachers (19%) indicated that multiple factors contributed to promoting pupils' motivation to learn mathematics. Some teachers thought that a particular teaching method could include these multiple factors. One 5th grade teacher wrote that practical work promoted pupils' interest and their understanding of the curriculum, and in turn, enhanced pupils' motivation to learn mathematics (ap.5.2.41.5th T). Other teachers thought that adopting several teaching methods, such as combining practical work to inspire pupils' interest and individual help to promote pupils' understanding of the curriculum (ap.5.2.42.5th T) would be beneficial in promoting pupils' motivation. Few 8th graders (N=8, 2%) and their teachers (N=2, 6%) proposed multiple factors.

Table 5.2: Percentages of teachers of both age groups and 8th graders who referred to different aspects of promoting pupils' motivation to learn mathematics

	5th grade teachers	8th grade teachers	8th graders
Encouraging pupils' involvement in mathematics learning	N=8 (25%)	N=7 (23%)	N=30 (7%)
Promoting pupils' interest in mathematics learning	N=7 (22%)	N=7 (23%)	N=116 (27%)
Meeting pupils' individual needs in mathematics learning	N=6 (19%)	N=6 (20%)	N=17 (4%)
Promoting pupils' understanding of the curriculum	N=3 (9%)	N=5 (18%)	N=108 (25%)
Developing pupils' mathematical thinking abilities	N=2 (6%)	N=3 (10%)	N=13 (3%)
Interaction with peers	--------------------	--------------------	N=26 (6%)
Interaction with the teacher	--------------------	--------------------	N=56 (13%)
Concentration	--------------------	--------------------	N=44 (10%)
Other reasons	--------------------	--------------------	N=16 (3%)
Multiple reasons	N=6 (19%)	N=2 (6%)	N=8 (2%)
Total	N=32 (100%)	N=30 (100%)	N=434 (100%)

Table 5.2 shows that between a quarter and a fifth of teachers of both age groups indicated that encouraging pupils' involvement, promoting their interest and catering for their individual needs contributed to promoting pupils' motivation. 8th grade teachers thought that promoting pupils' understanding of the curriculum would also promote their motivation to learn mathematics. For 8th graders, promoting their interest and understanding of the curriculum was perceived as contributing to motivation. More than one tenth of 8th graders mentioned that interaction with the teacher and concentration on the task promoted their motivation. However, teachers seemed unaware of these elements. Few 8th graders mentioned other factors such as competition, learning goals and positive previous experience of learning mathematics by a particular method. Some 5th grade teachers cited multiple reasons. In contrast, few 8th grade teachers and their pupils indicated a multiplicity of ways that pupils were motivated.

5.3: Teachers' and pupils' perceptions of the factors contributing to promoting pupils' sense of security in learning mathematics

Thirty-two 5th grade teachers (67%) and thirty-one 8th grade teachers (74%) responded to the question asking why they thought particular teaching methods promoted pupils' sense of security in learning mathematics. Responses of 404 8th graders to this question were analysed. Teachers of both age groups mentioned the same factors as had been raised in relation to promoting pupils' enjoyment and motivation. However, the percentages of teachers responding in relation to each aspect were different according to which aspect of pupils' affective attitudes was examined. The majority of the teacher participants said that catering for pupils' individual needs would promote pupils' sense of security. Seventeen teachers from each grade (53% at 5th grade; 55% at 8th grade) cited this element. Most teachers of both age groups mentioned that pupils' individual needs should be especially considered in terms of the individuals' current attainment in order to ensure pupils' sense of security in learning mathematics (ap.5.3.1.5th T; ap.5.3.2.8th T). Some teachers believed that pupils' individuality should be considered in terms of individual preferences of learning styles. One 5th grade teacher mentioned that discussion made pupils feel secure in learning mathematics by allowing pupils to be either active or passive in their learning according to their preference (ap.5.3.3.5th T). Catering for differences in learning pace was also perceived to ensure pupils' sense of security at both grades (ap.5.3.4.5th T; ap.5.3.5.8th T). 5th grade teachers believed that individual needs should be considered in terms of the pupils' interests as well (ap.5.3.6.5th T). Forty-three 8th graders (11%) considered that teaching methods which met individual needs could promote their sense of security. Most referred to pace in managing the task (ap.5.3.7.8th P) and pace in understanding of the problem (ap.5.3.8.8th P). In this sense, they preferred individualised teaching methods.

There were contrasting perspectives regarding whether pupils felt more secure in learning mathematics individually or in interaction with others. One teacher from each year group believed that pupils could enhance their sense of security in learning mathematics by satisfying their individual needs through interaction with the teacher and peers (ap.5.3.9.5th T). Some teachers, however, believed that avoidance of peer interaction would ensure pupils' sense of security, and that individualised learning methods were beneficial in this sense. Teachers suggested that such methods could reduce anxiety for children who were not skilled in peer interactions (ap.5.3.10.5th T). In addition, individualised learning methods, which protected pupils from the fear of making mistakes in public (ap.5.3.11.8th T) and being compared with others (ap.5.3.12.8th T), were perceived to ensure pupils' sense of security in mathematics learning. Some students wrote that they felt secure in individual learning because they could avoid being observed by others, as they felt nervous of being watched by others when they were learning mathematics in a whole-class session or group session (ap.5.3.13.8th P). Some students indicated that their sense of security in learning mathematics was threatened as the learning group became bigger (ap.5.3.14.8th P). In contrast, 22 students (5%) considered that interaction with peers made them feel more secure. One 8th grader said that they avoided the fear of being left behind by sharing learning opportunities with peers (ap.5.3.15.8th P). Fifty-eight students (14%) thought that interaction with the teacher ensured their sense of security in mathematics learning. As mentioned in previous sections, these students emphasised the actual interaction with the teacher rather than the cognitive growth produced by such interaction. The students believed that the teacher was sure to help pupils in need (ap.5.3.16.8th P) and that the teacher always paid attention to every student (ap.5.3.17.8th P). This made them feel secure.

Seven 5th grade teachers (23%) and four 8th grade teachers (13%) believed that promotion of pupils' understanding of the curriculum helped pupils feel secure. 5th grade teachers were more likely to recommend practical work, which promoted pupils' concrete

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thinking (ap.5.3.18.5th T), and group discussion, which offered opportunities for peer tutoring (ap.5.3.19.5th T) to promote pupils' sense of security through improving their understanding of the curriculum. 8th grade teachers were more likely to recommend teacher explanation, which gave pupils accurate information (ap.5.3.20.8th T) and individual help, which helped pupils have confidence in solving problems (ap.5.3.21.8th T). Eighty-nine 8th graders (22%) indicated that promoting their understanding of the curriculum would promote their sense of security. Some students mentioned that receiving help from the teacher when experiencing difficulties helped them to feel secure because their understanding of the curriculum was enhanced (ap.5.3.22.8th P). Some students wrote that they felt secure when they became surer how to manage the task as their understanding developed. Thus, receiving clear explanations about procedures from the teacher was perceived as very important for promoting their understanding, and thus their sense of security (ap.5.3.23.8th P).

Two 5th grade teachers (6%) and four 8th grade teachers (13%) indicated that developing pupils' mathematical thinking abilities would promote pupils' sense of security. Practical work, which encouraged pupils to think (ap.5.3.24.5th T), and discussion, which widened pupils' mathematical thinking abilities by sharing perspectives with peers (ap.5.3.25.8th T) were perceived to promote pupils' sense of security. The percentage of 8th graders pointing out that they felt secure when they found themselves developing their mathematics thinking abilities was also low (N=20, 5%). However, these students mentioned that they felt secure in mathematics learning through listening to others' perspectives (ap.5.3.26.8th P), raising their own views in a class or a group (ap.5.3.27.8th P) and sharing their perspectives with peers (ap.5.3.28.8th P). In this sense, discussion was perceived to promote their sense of security.

Teachers of both age groups pointed out that encouraging pupils' involvement in mathematics learning would promote pupils' sense of security as well as their enjoyment and motivation. However, the number of teachers stressing this element in promoting pupils' sense of security was small; three teachers from each grade (9% of the respondents to this question at 5th grade; 10% of the respondents to this question at 8th grade). These teachers suggested that pupils would feel secure in mathematics learning when they were actively involved in learning; practical work, where pupils with a wide range of prior attainments felt comfortable taking part (ap.5.3.29.5th T), and discussions where pupils put forwards their views positively (ap.5.3.30.5th T). Some teachers believed that pupils' autonomy in learning would encourage their positive involvement in mathematics learning and enable them to feel secure (ap.5.3.31.5th T). Discussion was perceived to promote pupils' sense of security through developing pupils' autonomy (ap.5.3.32.8th T). Fifty-three 8th graders (13%) pointed out that positive involvement in activities helped them feel secure. Their views reflected 8th graders' reported self-reliance in mathematics learning. One 8th grader wrote that doing work through her own effort rather than relying on others made her feel secure (ap.5.3.33.8th P).

Only one 8th grade teacher wrote that promoting pupils' interest in mathematics learning would ensure pupils' sense of security (ap.5.3.34.8th T), while no 5th grade teachers raised this. Overall, teachers did not perceive that promotion of pupils' interest in mathematics learning was related to their sense of security. Inspiring pupils' interest was perceived by some 8th graders to promote their sense of security as well as their enjoyment and motivation. However, the percentage of students perceiving this factor as promoting their sense of security was much smaller than the percentage perceiving it as promoting their enjoyment and motivation. Thirty-five 8th graders (9%) pointed out that inspiring pupils' interest would make them feel secure in mathematics learning. They mentioned that learning mathematics through using a computer (ap.5.3.35.8th P) or with new teaching methods (ap.5.3.36.8th P) would make their learning fun and them curious, as a result, their sense of security would be enhanced. Perhaps these teaching methods allow some pupils to escape from the anxiety developed in learning mathematics by conventional teaching methods.

Several factors were raised by 8th graders, but not their teachers. Fifty-eight 8th graders (14%) pointed out that concentration on work helped them feel secure. These students said that they felt secure in learning mathematics individually because they could concentrate on the task in individual sessions more easily than when listening to the teacher's explanation (ap.5.3.37.8th P) or learning mathematics in a group (ap.5.3.38.8th P). Six 8th graders (2%) mentioned other factors such as being accustomed to the learning methods (ap.5.3.39.8th P) and previous good experiences with using the methods (ap.5.3.40.8th P). These views contrasted with those of students who saw new methods promoting a sense of security. The numbers of students perceiving that new teaching methods would promote their sense of security and the number mentioning that they felt secure in using accustomed teaching methods were very similar.

Three 5th grade teachers (10%) and two 8th grade teachers (6%) suggested multiple factors as promoting pupils' sense of security. As described in the previous sections, some teachers believed that one particular teaching method could fulfil multiple factors. One 5th grade teacher suggested that practical activities could ensure pupils' sense of security, through promoting pupils' interest and autonomy in learning and their understanding of the curriculum and mathematical thinking abilities (ap.5.3.41.5th T). Other teachers thought that the adoption of several different teaching methods was more beneficial in promoting pupils' sense of security than selecting a particular teaching method. One 5th grade teacher suggested that a combination of discussion, whereby pupils develop their mathematical thinking abilities through sharing ideas with peers, and individualised teaching methods to enable them to think independently and receive individual help, made pupils feel secure. This teacher suggested that such combinations allowed pupils to apply findings obtained in one session in another session and created synergy (ap.5.3.42.5th T).

Twenty 8th graders (5%) suggested multiple factors as promoting a sense of security. Half of them stressed that understanding the curriculum through individual work and receiving individual help promoted a sense of security (ap.5.3.43.8th P). Various combinations were suggested as promoting pupils' sense of security, but the number of the students citing each combination was very few.

Large differences emerged in perceptions of the factors contributing to pupils' sense of security compared with those contributing to their enjoyment and motivation. More than one fifth of 8th graders responded that promoting their understanding of the curriculum helped them feel secure in mathematics learning, as opposed to 13% of teachers. This aspect was emphasised more by 5th grade than by 8th grade teachers. The majority of teachers perceived that meeting individual needs was a major factor contributing to promoting pupils' sense of security, while only 11% of students did so. Some pupils mentioned that interaction with peers and with the teacher helped them feel secure, while others mentioned that they felt more secure in individual sessions. Teachers seemed to believe that avoidance of interaction with peers promoted security more than interaction with peers. Some teachers perceived that pupils' positive and autonomous involvement in mathematics learning was the key factor contributing to a sense of security, although the number of teachers suggesting this element as important was much smaller than in relation to enjoyment or motivation. 13% of 8th graders supported this view. They perceived that making a constant effort in learning mathematics helped them feel secure. Very few teachers and pupils reported developing pupils' mathematical thinking abilities and their interest in mathematics as important in promoting their sense of security.

Table 5.3: Percentages of teachers of both age groups and 8th graders who referred to different aspects of promoting pupils' sense of security in learning mathematics

	5th grade teachers	8th grade teachers	8th graders
Encouraging pupils' involvement In mathematics learning	N=3 (9%)	N=3 (10%)	N=53 (13%)
Promoting pupils' interest in mathematics learning	N=0 (0%)	N=1 (3%)	N=35 (9%)
Meeting pupils' individual needs in mathematics learning	N=17 (53%)	N=17 (55%)	N=43 (11%)
Promoting pupils' understanding of the curriculum	N=7 (23%)	N=4 (13%)	N=89 (22%)
Developing pupils' mathematical thinking abilities	N=2 (6%)	N=4 (13%)	N=20 (5%)
Interaction with peers	--------------------	--------------------	N=22 (5%)
Interaction with the teacher	--------------------	--------------------	N=58 (14%)
Concentration	--------------------	--------------------	N=58 (14%)
Other reasons	--------------------	--------------------	N=6 (2%)
Multiple reasons	N=3 (9%)	N=2 (5%)	N=20 (5%)
Total	N=32 (100%)	N=31 (100%)	N=404 (100%)

5.4: Teachers' and pupils' perceptions of the factors contributing to pupils' sense of progress in learning mathematics

Thirty-five 5th grade teachers (73%) and thirty-two 8th grade teachers (76%) responded to the question asking why they thought that particular teaching methods promoted pupils' sense of progress. Responses of 418 8th graders to this question were analysed. Teachers of both age groups perceived that the same factors contributed to pupils' sense of progress as contributed to their enjoyment, motivation and sense of security. Firstly, meeting individual needs was perceived by many teachers to promote pupils' sense of progress as well as their sense of security. Twelve 5th grade teachers (34% of the respondents) and nine 8th grade teachers (28% of the respondents) perceived that meeting pupils' individual needs would promote the their sense of progress. Most of these teachers suggested that consideration of individual differences in attainment was needed to promote pupils' sense of progress (ap.5.4.1.5th T), especially at 8th grade, as wide individual differences existed in pupils' attainment within a class (ap.5.4.2.8th T). However, few 8th graders agreed (N=17, 4%). Some mentioned that they felt a sense of progress when they learned mathematics at their own pace (ap.5.4.3.8th P). Others mentioned that they felt progress when individualised methods were used, because they could focus on doing exercises according to their needs (ap.5.4.4.8th P).

Secondly, eight teachers from each grade (23% at 5th grade; 25% at 8th grade) thought that promotion of pupils' understanding of the curriculum would promote their sense of progress. These teachers thought that practical activities, which allowed pupils to learn mathematics through experience (ap.5.4.5.8th T), and teacher explanation, whereby teachers could explain accurately what the pupils had not mastered (ap.5.4.6.5th T), promoted pupils' understanding of the curriculum, and subsequently, pupils would feel more progress. Other teachers considered that pupils' sense of progress could be enhanced by improving their understanding of the curriculum through doing exercises repeatedly or reading a textbook. Some teachers mentioned that adopting a range of teaching methods would be beneficial to promote pupils' understanding of the curriculum. One 5th grade teacher mentioned that the combination of practical work and teacher explanation would be most effective in promoting pupils' understanding of the curriculum and hence sense of progress, because pupils need to be taught knowledge to support their experiences obtained through practical activities (ap.5.4.7.5th T). Approximately three out of ten 122 8th graders (29%) indicated that promotion of their understanding of the curriculum would enhance their sense of progress. Promotion of such understanding was perceived by many 8th graders to relate to all of the four facets of affective attitudes towards mathematics learning. One student wrote that doing exercises after listening to the teacher's explanation was effective in promoting understanding of the curriculum (ap.5.4.8.8th P), while another student wrote that reading a textbook repeatedly after listening to the teacher's explanation was effective (ap.5.4.9.8th P).

Thirdly, five 5th grade teachers (14%) and six 8th grade teachers (19%) suggested that encouraging pupils' involvement in mathematics learning promoted a sense of progress. Autonomous and active learning activities, such as discussion whereby pupils could raise their views positively, was perceived to promote a sense of progress (ap.5.4.10.8th T). The same issues were raised as in the previous sections. Sixty-nine 8th graders (17%) indicated that positive involvement in activities was important. Pupils saw involvement in activities in terms of self-reliance. They perceived that accumulation of individual effort (ap.5.4.11.8th P) and cultivating individual competencies by individual effort (ap.5.4.12.8th P) was important in promoting their sense of progress.

Fourthly, four teachers from each grade (12% at 5th grade; 13% at 8th grade) considered that developing mathematical thinking abilities promoted pupils' sense of progress. Most of these teachers recommended adopting discussion-style teaching methods, either whole-class discussion or group discussion, to develop pupils' sense of progress (e.g. ap.5.4.13.5th T). The percentage of 8th graders considering that they felt a sense of progress as they were developing mathematical thinking abilities was low (N=14, 3%). One 8th grader wrote that he felt a sense of progress when he was aware of developing abstract thinking abilities through finding different perspectives through having discussions (ap.5.4.14.8th P), while another wrote that she felt progress when she could put forward her views in individual or group learning (ap.5.4.15.8th P).

Although promoting pupils' interest in mathematics learning was perceived by teachers to promote pupils' enjoyment and motivation, teachers did not seem to think that this aspect was important for promoting pupils' sense of security and sense of progress. Fourteen 8th graders (3%) pointed out that teaching methods which inspired their interest were important. Only one student mentioned that learning mathematics through a new method enhanced their sense of progress (ap.5.4.16.8th P).

Eleven 8th graders (3%) suggested that interaction with peers developed a sense of progress, because peers could be asked about areas of uncertainty and provide clarification (ap.5.4.17.8th P). More pupils pointed out interactions with the teacher rather than peers as important in giving them a sense of progress; 95 8th graders (23%) did so. Some of them mentioned that receiving help from the teacher encouraged them to learn mathematics to repay the teachers' kindness, and as a result of this effort, they developed a sense of progress (ap.5.4.18.8th P). For these students, the interaction itself rather than the enhancing of cognitive development through interaction promoted a sense of progress. Interaction with the teacher and peers was, thus, perceived by students to promote their affective attitudes towards mathematics learning, although teachers did not take this point very seriously. Thirty-six 8th graders (9%) pointed out that concentration on the tasks provided was important to a sense of progress in mathematics learning. Many perceived that they could concentrate better in individual or small group sessions than in whole-class sessions (ap.5.4.19.8th P).

Six 8th graders (1%) suggested other factors as promoting their sense of progress in mathematics learning. Of these, five wrote that their sense of progress was enhanced by methods, which they were familiar with. They had confidence that they had made progress in learning mathematics by the methods used so far (ap.5.4.20.8th P). Although the number of the pupils stating this was small, it was larger than the number of the pupils considering that learning mathematics through new methods could promote a sense of progress. One student mentioned that competition with peers promoted their sense of progress.

Six 5th grade teachers (17%) and five 8th grade teachers (15%) suggested multiple factors as contributing to promoting pupils' sense of progress; most of them mentioned pupils' understanding of the curriculum and one other factor. Some teachers perceived that a particular teaching method could achieve several goals necessary for promoting pupils' sense of progress. For instance, one 8th grade teacher mentioned that individualised teaching methods could meet pupils' individual needs in mathematics learning, while promoting pupils' understanding of the curriculum, both of which were perceived necessary to promote a sense of progress (ap.5.4.21.8th T). Others believed that the combined adoption of several different teaching methods was necessary to promote pupils' sense of progress. For instance, one 5th grade teacher believed that combination of practical work, to promote pupils' understanding of the curriculum, and discussion, to develop pupils' mathematical thinking abilities was necessary (ap.5.4.22.5th T). There were contrasting views as to whether a particular teaching method could satisfy all of the requirements for promoting pupils' affective attitudes, or whether several different teaching methods should be adopted for the purpose.

Thirty-four 8th graders (8%) raised multiple factors as promoting a sense of progress. Of these, ten linked promotion of understanding of the curriculum and satisfying individual needs as important to promote this sense (ap.5.4.23.8th P). Another 12 students suggested combinations of promotion of understanding of the curriculum and other factors, such as inspiring interest, encouragement of active involvement, interaction with friends, concentration and meeting individual needs. This finding suggests that both teachers and pupils believe that improving pupils' understanding of the curriculum is crucial for promoting pupils' sense of progress.

Table 5.4: Percentages of teachers of both age groups and 8th graders who referred to different aspects of promoting pupils' sense of progress in learning mathematics

	5th grade teachers	8th grade teachers	8th graders
Encouraging pupils' involvement in mathematics learning	N=5 (14%)	N=6 (19%)	N=69 (17%)
Promoting pupils' interest in mathematics learning	N=0 (0%)	N=0 (0%)	N=14 (3%)
Meeting pupils' individual needs in mathematics learning	N=12 (34%)	N=9 (28%)	N=17 (4%)
Promoting pupils' understanding of the curriculum	N=8 (23%)	N=8 (25%)	N=122 (29%)
Developing pupils' mathematical thinking abilities	N=4 (12%)	N=4 (13%)	N=14 (3%)
Interaction with peers	--------------------	--------------------	N=11 (3%)
Interaction with the teacher	--------------------	--------------------	N=95 (23%)
Concentration	--------------------	--------------------	N=36 (9%)
Other reasons	--------------------	--------------------	N=6 (1%)
Multiple reasons	N=6 (17%)	N=5 (15%)	N=34 (8%)
Total	N=35 (100%)	N=32 (100%)	N=418 (100%)

Table 5.4 shows that many teachers believed that meeting pupils' individual needs in mathematics learning and improving pupils' understanding of the curriculum promoted pupils' sense of progress. Over 50% of the respondents at both grades raised these issues. In addition, for those teachers citing multiple methods, reference to improving pupils' understanding of curriculum was one of the factors mentioned. Thus, teachers of both age groups believed that these two aspects were important to promote pupils' sense of security and sense of progress. 8th graders believed that promotion of understanding of the curriculum and interacting with the teacher were important, but few raised meeting individual needs as important. Some teachers considered that

encouraging pupils' involvement in mathematics learning and developing mathematical thinking abilities were important. Some 8th graders also perceived positive involvement in learning, i.e. making a constant effort to learn mathematics, as important. Few 8th graders stressed the importance of developing mathematical thinking abilities for a sense of progress. Overall, both teachers and 8th graders did not believe that promoting pupils' interest in mathematics learning was an important factor in promoting their sense of progress.

5.5: Summary of Chapter 5

Table 5.5 shows the percentages of teachers of both age groups and 8th graders who mentioned each aspect of promoting pupils' affective attitudes towards mathematics learning. The most important finding here is the extent to which 8th graders believed that promoting their understanding of the curriculum contributes to promoting all four aspects of affective attitudes. Teachers agreed with this. Overall, teachers seemed to have a dichotomised perspective on the factors contributing respectively to pupils' enjoyment and motivation and to their sense of security and sense of progress. They indicated that encouraging pupils' involvement in mathematics learning and promoting pupils' interest in this learning was important for the promotion of their enjoyment and motivation, while meeting pupils' individual needs in mathematics learning and promoting their understanding of the curriculum were important for promoting their sense of progress and sense of security. This was especially the case for 5th grade teachers. 8th grade teachers believed that promoting pupils' understanding of the curriculum could promote pupils' enjoyment in learning mathematics.

8th graders believed that promotion of pupils' interest in mathematics learning was important for enjoyment and motivation, while involvement was more important for their sense of security and sense of progress than enjoyment and motivation. This is probably because teachers seemed to define pupils' involvement in mathematics learning as pupils' being involved in positive and autonomous activities. Pupils defined involvement as a self-reliant learning style, for instance making a constant effort to learn mathematics. Few 8th graders considered that meeting pupils' individual needs in mathematics learning was important for their affective attitudes. Some 5th grade teachers believed that developing pupils' mathematical thinking abilities was enjoyable for pupils, although this element was, overall, not perceived as promoting pupils' affective attitudes towards mathematics learning. Some 8th graders cited interaction with peers and teachers, but teachers of both age groups did not acknowledge these elements. Few teachers or pupils cited multiple reasons, and most cited were combinations of the factors mentioned above.

Although some respondents suggested that particular teaching methods could promote pupils' positive affective attitudes towards learning mathematics, their perceptions of the teaching methods which did so were diverse. This was particularly the case for pupils' perceptions of the teaching methods promoting their interest in mathematics learning and understanding of the curriculum. Thus, wide individual differences existed in the teaching methods through which pupils had experienced interest in and understanding of, the curriculum. Some pupils seemed to favour learning mathematics individually, while others preferred to learn in interaction with peers. Some pupils favoured learning mathematics through familiar methods, while others wanted to try new teaching methods, which inspired curiosity. Although the number of pupils raising this issue was small, it nevertheless draws attention to the wide variability in pupils' views of what supports their learning. Secondly, some of those who cited multiple reasons believed that a particular teaching method could promote several aspects needed for promoting pupils' affective attitudes, while others believed that the combination of several teaching methods was effective. Overall, there does not seem to be a consensus regarding what might be most effective in promoting positive attitudes.

Table 5.5: Percentage of teachers of both age groups and 8th graders who referred to each aspect of promoting pupils' affective attitudes of learning mathematics

	5th grade teachers		8th grade teachers		8th graders	
Encouraging pupils' involvement in mathematics learning						
Enjoyment	27%	N=9	32%	N=10	2%	N=11
Motivation	25%	N=8	23%	N=7	7%	N=30
Sense of security	9%	N=3	10%	N=3	13%	N=53
Sense of progress	14%	N=5	19%	N=6	17%	N=69
Promoting pupils' interest in mathematics learning						
Enjoyment	23%	N=8	20%	N=6	30%	N=142
Motivation	22%	N=7	23%	N=7	27%	N=116
Sense of security	0%	N=0	3%	N=1	9%	N=35
Sense of progress	0%	N=0	0%	N=0	3%	N=14
Meeting pupils' individual needs in mathematics learning						
Enjoyment	11%	N=4	16%	N=5	4%	N=17
Motivation	19%	N=6	20%	N=6	4%	N=17
Sense of security	53%	N=17	55%	N=17	11%	N=43
Sense of progress	34%	N=12	28%	N=9	4%	N=17
Promoting pupils' understanding of the curriculum						
Enjoyment	11%	N=4	20%	N=6	29%	N=136
Motivation	9%	N=3	18%	N=5	25%	N=108
Sense of security	23%	N=7	13%	N=4	22%	N=89
Sense of progress	23%	N=8	25%	N=8	29%	N=122
Developing pupils' mathematical thinking abilities						
Enjoyment	17%	N=6	6%	N=2	5%	N=23
Motivation	6%	N=2	10%	N=3	3%	N=13
Sense of security	6%	N=2	13%	N=4	5%	N=20
Sense of progress	12%	N=4	13%	N=4	3%	N=14
Interaction with peers						
Enjoyment	--------------------		--------------------		13%	N=59
Motivation					6%	N=26
Sense of security					5%	N=22
Sense of progress					3%	N=11
Interaction with the teacher						
Enjoyment	--------------------		--------------------		4%	N=18
Motivation					13%	N=56
Sense of security					14%	N=58
Sense of progress					23%	N=95
Concentration						
Enjoyment	--------------------		--------------------		3%	N=12
Motivation					10%	N=44
Sense of security					14%	N=58
Sense of progress					9%	N=36
Other reasons + Multiple reasons						
Enjoyment	11%	N=4	6%	N=2	10%	N=48
Motivation	19%	N=6	6%	N=2	5%	N=24
Sense of security	9%	N=3	5%	N=2	7%	N=26
Sense of progress	17%	N=6	15%	N=5	9%	N=40

CHAPTER 6: TEACHERS' PERCEPTIONS OF TEACHING METHODS ADOPTED IN MATHEMATICS CLASSES

This chapter presents the results of the analysis of the qualitative interview data. 20 teachers of 5th graders and 12 teachers of 8th graders took part in the interview phase. All data obtained in the interviews were transcribed and translated from Japanese to English. Responses were categorised. Comparisons were made between teachers of 5th graders and teachers of 8th graders.

6.1: Teachers' perceptions of pupils' affective attitudes towards mathematics learning

This section considers two main sub-questions. One is whether teachers believed that the promotion of pupils' enjoyment, motivation, sense of security and sense of progress were important in their mathematics classes, and if so why they thought in this way. The second is the way that teachers assessed pupils' enjoyment, motivation and sense of security in learning mathematics. For pupils' sense of progress, teachers were asked to express their ideas on when they felt that their pupils made progress in their mathematics learning, and when they believed that pupils themselves had a sense of progress in mathematics learning.

Pupils' enjoyment in mathematics learning

Although seventeen out of twenty 5th grade teachers (85%) and ten out of twelve (83%) 8th grade teachers expressed their agreement that promoting pupils' enjoyment was important, some teachers expressed neutral or less positive beliefs. Two main reasons emerged regarding the importance of promoting enjoyment. First, teachers pointed out that promoting pupils' enjoyment in mathematics learning could prevent pupils from becoming disaffected. One 5th grade teacher was aiming to provide enjoyable mathematics learning, in order to reduce pupil disaffection towards mathematics learning (ap.6.1.1.5th). The other reason for promoting pupils' enjoyment in mathematics learning was to improve motivation. For instance, a 5th grade teacher commented that the provision of enjoyable mathematics lessons would be the starting point in promoting pupils' motivation. Boring lessons could reduce pupils' motivation (ap.6.1.2.5th). An 8th grade teacher working at a girls' junior high school hoped that female students would choose mathematics for further study in higher education if they enjoyed mathematics learning while young. She commented that teachers had the responsibility for ensuring that students experienced enjoyment in mathematics when it was compulsory (ap.6.1.3.8th).

Three 5th grade teachers (15%) and two 8th grade teachers (17%) expressed neutral or less positive beliefs. Some teachers believed that improving pupils' sense of progress and confidence was more important than ensuring that pupils experienced enjoyable activities. One 5th grade teacher commented that it was too late to enable 5th graders to value learning mathematics by providing enjoyable lessons, because children had formed stable feelings towards mathematics by 5th grade. This teacher suggested that developing a mastery-oriented classroom ethos and encouraging pupils to have confidence in mathematics learning was more important than making lessons merely enjoyable (ap.6.1.4.5th). Another issue raised was the need to cover the curriculum. For instance, one 5th grade teacher said that although she realised that children could retain what they had learned in long-term memory better when they learned mathematics through inspiration arising from enjoyable activities rather than memorisation, the pressured curriculum did not allow such a relaxed teaching approach (ap.6.1.5.5th). Parents were also a factor. Another 5th grade teacher said that she had to give precedence to improving pupils' attainment in order to satisfy parental demands, especially in mathematics (ap.6.1.6.5th). Such parental and social expectations regarding improving attainment seemed to increase as children proceeded through the grades. This is because mathematics is normally required for the entrance examination for high schools in Japan. Attaining the level of the high school examination therefore is an important factor, and more important than considering pupils' enjoyment in mathematics learning for 8th grade teachers. One 8th grade teacher confessed that he felt tensions between his desire that pupils should like learning mathematics and his need to cram them with knowledge and skills to get through the entrance examination (ap.6.1.7.8th). Some teachers (ap.6.1.8.8th) said that it was difficult to promote enjoyment because individual pupils liked different things.

Two 5th grade teachers (10%) and three 8th grade teachers (25%) stressed that pupils concentrated on their work when they were enjoying lessons, while they might be off task when they felt bored. One 5th grade teacher (ap.6.1.9.5th) and one 8th grade teacher (ap.6.1.10.8th) made similar comments. Eight 5th grade teachers (40%) pointed out that they could assess pupils' enjoyment from the extent to which pupils seemed to be actively involved in the activities. They suggested that:

- Pupils try to understand what they are doing when they are enjoying lessons;
- Pupils make notes tidily, are actively involved in discussion and deal with tasks autonomously when they are enjoying lessons;
- Pupils ask a lot of questions when they are enjoying lessons;
- Pupils try to find out various ways to solve problems in enjoyable lessons.

Four 5th grade teachers (20%) pointed out that pupils' facial expressions reflected their enjoyment. However, one 5th grade teacher mentioned that it was sometimes difficult to assess the extent to which the pupils were enjoying lessons from their behaviour or facial expressions, because these do not always mirror their feelings (ap.6.1.11.5th). This teacher pointed out that teachers might be able to learn to assess pupils' affective attitudes from the atmosphere in a classroom. He indicated that he was able to observe coherence and a common goal in a class where pupils were enjoying learning mathematics.

Pupils' motivation to learn mathematics

All of the teachers said that the promotion of pupils' motivation to learn mathematics was important. Two main reasons emerged for this: a reduction in disaffection (e.g. ap.6.1.12.5th) and an increase in progress (e.g. ap.6.1.13.8th). One 8th grade teacher commented that teachers could recognise unmotivated pupils because their behaviour was different (ap.6.1.14.8th). Three 5th grade teachers (15%) mentioned that pupils' motivation to learn mathematics was reflected in their positive, autonomous, and careful involvement with the work. Teachers felt it important to prepare lessons whereby every pupil was involved in order to promote pupils' motivation to learn (ap.6.1.15.5th). Four 5th grade teachers (20%) and eight 8th grade teachers (67%) said that when pupils were unmotivated to learn, they complained about boredom or difficulties, became less responsive to the teacher's questions and were unwilling to put forward their views. One 8th grade teacher commented that pupils seemed to have lost the desire to master the content when their motivation to learn mathematics was low (ap.6.1.16.8th). Pupils' unmotivated attitudes were more noticeable in the classroom at 8th grade than at 5th grade, and teachers' concern about pupils' unmotivated attitudes seemed to increase with grade. One 8th grade teacher argued that teachers might sometimes only be able to notice a decrease in a particular pupil's motivation from deteriorated test performance. He mentioned that such a deterioration might arise from a decrease in motivation to learn mathematics at home, and that learning mathematics at school might not be enough to maintain the quality of test performance (ap.6.1.17.8th). Overall, teachers believed that promoting pupils' motivation to learn mathematics was more important than promoting pupils' enjoyment.

Pupils' sense of security in learning mathematics

Seventeen 5th grade teachers (85%) and nine 8th grade teachers (75%) perceived that the promotion of pupils' sense of security was important. These teachers believed that pupils' anxiety in mathematics classes could have negative effects on their attitudes towards mathematics learning and the development of their personality. Reducing anxiety with help from peers might support pupils' affective and personal development positively. This view was common in 5th grade teachers who valued the education of the whole-person. Such beliefs were reflected in many teachers' statements. For instance, many 5th grade teachers believed that co-operation, communication, mutual support from peers (ap.6.1.18.5th), and mutual acceptance (ap.6.1.19.5th) promoted pupils' sense of security. Another 5th grade teacher suggested that pupils' feeling secure in mathematics learning might depend on the teachers' capabilities of building up mutual trust in the class (ap.6.1.20.5th). Pupils' sense of security was perceived to relate to good relationships with peers at 8th grade as well. Teachers did not think that pupils' anxiety was merely caused by their difficulties encountered in tasks (e.g. 6.1.21.8th). Some teachers indicated that preventing all the pupils in a classroom from feeling anxious was difficult, although they admitted that promoting pupils' sense of security in mathematics classes was important. They perceived that the characteristics of mathematics, whereby a right answer was required, would be more likely to increase pupils' anxiety in learning mathematics than learning languages, whereby presenting alternative views was acceptable. In addition, teaching methods which produced pupil anxiety might be different from one pupil to another. One 8th grade teacher indicated that pupils' current attainments, their characteristics, their experience of using particular learning methods and their need to interact with peers in a class would affect the extent to which they felt anxious in learning mathematics through particular teaching methods (ap.6.1.22.8th).

Three 5th grade teachers (15%) and three 8th grade teachers (25%) indicated that the promotion of pupils' sense of security was less important than the promotion of enjoyment, motivation and sense of progress (ap.6.1.23.5th; ap.6.1.24.8th). These teachers thought that teachers' concern for pupils' sense of security was less necessary, because pupils might not be conscious about whether they felt secure or not in mathematics classes (ap.6.1.25.5th). One 8th grade teacher altered his view through taking part in the research. He had attempted to ensure that pupils felt positive about learning mathematics by improving their attainment, and did not consider his pupils' feelings of security in mathematics classes. However, he noticed during the research that his pupils might feel anxious because of the social dynamics in classes, and now he considered how to reduce pupils' anxiety (ap.6.1.26.8th).

Pupils' sense of progress in learning mathematics

As described above, some teachers expressed neutral or less positive views on the necessity of promoting their pupils' enjoyment and sense of security. In contrast, there was a consensus among teachers that promoting pupils' sense of progress was important at both grades. Some teachers believed that pupils' sense of progress was closely related to their actual mathematics attainment. They believed that pupils' sense of progress in mathematics learning was important in order to ensure that pupils acquired mathematical knowledge and competencies, fundamental in later life (see ap.6.1.27.5th). Others believed that pupils' sense of progress or confidence in learning mathematics might not be related to their actual attainment. One 8th grade teacher commented that pupils' sense of progress was more important than attainment itself, because it was the pupils' sense of progress rather than attainment that would develop their confidence, motivation and enjoyment in learning (ap.6.1.28.8th). One 5th grade teacher described how parental expectation had been changed, from wanting improvement in their children's actual attainment to promotion of their children's positive attitudes including enhancing their confidence in learning (ap.6.1.29.5th). He suggested that social expectations of education in Japan were changing, as the current educational reforms implied. His view contrasted with other teachers' views that parental expectations of improvement in their children's attainment might be an obstacle to adopting enjoyable activities.

Overall, 5th grade teachers indicated that they felt that their pupils made progress in the following cases, although some teachers cited multiple factors:

- When pupils developed their mathematical ideas (N=14, 70%);
- When pupils understood the principles of the content (N=5, 25%);
- When pupils were able to manage the task and calculate accurately and quickly (N=3, 15%);
- When pupils showed more positive attitudes towards mathematics learning (N=5, 25%).

5th grade teachers believed that the development of mathematical ideas and understanding the principles of the content were more important indicators of pupils' progress than improved memorisation and manipulation of formulas. 5th grade teachers thought that pupils' analogy, reasoning, deductive thinking, inductive thinking, expression and examination should be promoted. Some teachers valued developing pupils' deductive thinking (e.g. ap.6.1.30.5th); these teachers emphasised the importance of developing pupils' understanding of the principles of content rather than the acquisition of means of manipulation (ap.6.1.31.5th). Other teachers favoured developing pupils' inductive rather than deductive thinking. One 5th grade teacher commented that inductive thinking processes, whereby pupils collected as much information as possible to lead to a conclusion, could avoid the memorisation and manipulation of formulas and develop children's inspiration (ap.6.1.32.5th). 5th grade teachers seemed to think that developing mathematical ideas was especially important when studying shape. One 5th grade teacher mentioned that when teaching about shape he attempted in various ways to promote pupils' mathematical ideas, such as competencies to examine a problem, while he gave priority to the acquisition of fundamental knowledge and skills to solve problems accurately and quickly when learning about number (ap.6.1.33.5th). These teachers, at the same time, suggested the development of pupils' mathematical ideas or the improvement of pupils' attitudes as indicators of pupils' progress. No teachers believed that managing tasks and calculations was the only indicator of pupils' progress in mathematics learning. Some teachers thought that positive learning attitudes might be indicators of pupils' progress, even if they did not necessarily link to better performance. The teachers stated that they felt that pupils made progress in mathematics learning in the following cases:

- When they developed independent thinking, such as when trying to think out the problem or new tasks by themselves;
- When they reduced their negative feelings about mathematics learning, noticing that they could master the learning content if they tried hard to do so.
- When they showed greater willingness to share their understanding with their peers;
- When they were more positively involved in learning, for example, raising hands to answer questions, putting forward views in discussion and asking concrete questions.

5th grade teachers also seemed to think that their pupils might feel a sense of progress from concrete results such as better performance in lessons and test settings. Teachers supposed that pupils felt a sense of progress in the following cases:

- When they began to get higher marks in mathematics tests (N=15, 75%);
- When they began to find answers accurately and quickly (N=10, 50%),
- When they could raise views in discussion and get approval from the teacher and classmates (N=4, 20%);
- When they could understand content (N=3, 15%).

Most teachers complained that pupils were likely to put too much emphasis on such tangible results. One 5th grade teacher mentioned that when children put too much stress on better results it could lead to a neglect of processes, although he admitted that results such as approval and praise in discussion might give the child confidence (ap.6.1.34.5th).

8th grade teachers also perceived that understanding of content (N=4, 33%) and development of mathematical ideas (N=5, 42%) were indicators of pupils' progress in mathematics learning. They believed that understanding the content written in a textbook (ap.6.1.35.8th) and teachers' explanation of that content (ap.6.1.36.8th) was more than memorisation of formulae. One 8th grade teacher explained that pupils who have understood the principles can find out why they have got a wrong answer and amend their understanding, while pupils memorising the formula believe that their wrong answers are due to their carelessness in manipulating the formula and normally progress more slowly (ap.6.1.37.8th). Teachers seeking a sense of progress in the pupils' development of mathematical ideas believed that developing pupils' mathematics ideas could enhance pupils' affective attitudes such as interest, motivation, sense of accomplishment and confidence (ap.6.1.38.8th). Some of these teachers mentioned that they valued pupils' independent thinking, and made ample opportunities to assess pupils' thinking processes through encouraging pupils to raise views in class and examining pupils' notebooks regularly (ap.6.1.39.8th). Almost all of the 8th grade teachers believed that their pupils would develop their sense of progress from their results, as did 5th grade teachers. However, 8th grade teachers emphasised less the discrepancies between what they believed pupils' sense of progress was and what they supposed pupils perceived as a sense of progress. 8th grade teachers seemed to understand that pupils at this age level required tangible evidence of their progress towards the high school entrance examination. Their tone was sympathetic rather than critical (ap.6.1.40.8th).

Summary of 6.1

Almost all the teachers believed that the promotion of pupils' enjoyment, motivation, sense of security and sense of progress was important. They believed that positive attitudes towards mathematics learning resulted in the improvement of mathematics performance; motivation and sense of progress were particularly stressed. Some teachers mentioned that pupils' positive and negative attitudes were observable through classroom behaviour, while others mentioned that teachers might not notice a deterioration of pupils' attitudes. Promotion of pupils' sense of security was perceived by some to be important for the development of pupils' personality, especially at 5th grade.

However, in general teachers perceived that it was difficult to ensure pupils' enjoyment and sense of security because of individual differences, the pressured curriculum, the rigorous entrance examination system and parental concerns about their children's attainment. These difficulties increased at 8th grade. Some teachers believed that their pupils rarely felt anxiety in mathematics classes. Many teachers perceived that pupils measured progress from tangible results. This was a particular concern especially for 5th grade teachers, who valued learning processes.

6.2: Teachers' perceptions of teaching methods adopted in mathematics classes

This section presents the results of analysing the data on the perceived advantages and disadvantages of each teaching method. The study explored eight teaching methods, *Practical work*, *Using a computer*, *Reading a textbook*, *Teacher explanation*, *Individual work*, *Individual help, Whole-class discussion* and *Group discussion.* However, in the interviews, *Individual work* and *Individual help* were combined as *Individual learning*, and *Whole-class discussion* and *Group discussion* were combined as *learning mathematics through discussion*, in order to simplify the process.

Practical work

The most notable advantage of practical work which the teachers mentioned was that it could promote pupils' understanding of the curriculum. Eight 5th grade teachers (40%) and three 8th grade teachers (25%) perceived that learning mathematics through experience, observation and practical activities could promote understanding in pupils of a wide range of attainment. One 5th grade teacher explained that learning mathematics through observation was especially beneficial to promote pupils' understanding of volume and capacity, which it was difficult to achieve through drawings on the blackboard or verbal explanation (ap.6.2.1.5th). Learning mathematics through experience was also perceived as more effective than memorising formulae in terms of retaining material in long-term memory (ap.6.2.2.5th). Secondly, practical work was perceived to help develop pupils' mathematical ideas. Seven 5th grade teachers (35%) and three 8th grade teachers (25%) stressed this. Of these teachers, three from each teaching age group pointed out that pupils could share findings from practical activities with the whole class to develop their ideas. This method was described as a Problem-Solving Teaching Method and was described in detail in chapter one. One 5th grade teacher mentioned that this teaching method was effective in promoting pupils' mathematical ideas, because teachers could plan the lessons based on an understanding of the individual pupil's ideas and attainments (ap.6.2.3.5th). Four 5th grade teachers (20%) mentioned that learning mathematics in a trial and error learning style through practical activities was effective in promoting pupils' mathematical ideas in a concrete way, especially in relation to shape. This trial and error learning style was perceived to help pupils adapt existing knowledge to new problems, correct their misunderstandings and construct new concepts more efficiently than explaining the concept to the pupils on the blackboard (ap.6.2.4.5th). Thirdly, practical work was perceived to promote pupils' interest in mathematics learning. Three 5th grade teachers (15%) and two 8th grade teachers (17%) drew attention to this. Adoption of *Practical work* in mathematics lessons was perceived as something new for pupils, which would in turn, promote their interest. Teachers observed that pupils favoured doing practical activities rather than listening to teacher's explanations. Activity-based lessons were perceived to avoid results-based evaluations and take account of individual interests and learning preferences. As a result of this, such lessons promoted pupils' motivation to learn mathematics (see 6.2.5.8th).

There were two main advantages of *Practical work*, which 5th grade teachers pointed out but 8th grade teachers did not. First, 5th grade teachers perceived that practical work could link what pupils had learnt in lessons and what they had experienced in their everyday life. Five 5th grade teachers (25%) expressed this view. *Practical work* was perceived as beneficial for three main reasons. It made new mathematics concept more familiar to pupils (ap.6.2.6.5th). It developed pupils' competencies in applying mathematics to everyday life (ap.6.2.7.5th); it made up for a lack of capabilities which should have been acquired through experience in everyday life. One teacher mentioned that the children of today especially lack sensory capabilities such as conceptions of quantity and weight (ap.6.2.8.5th). The other advantage of practical work which only 5th grade teachers pointed out was that it could encourage all the pupils to take part in activities positively and autonomously, irrespective of their individual current attainment or their current knowledge of the topic. Three 5th grade teachers (15%) pointed out this advantage. *Practical work* was, as a result, perceived to promote enjoyment, motivation to learn and the mathematics efficacy of most pupils, including those who might not succeed through other learning methods. It could also provide opportunities for teachers to detect competencies which might not be found in test performance, especially of pupils who were less good at mathematics, and provide opportunities for pupils to get approval and build confidence. *Practical work* was also perceived as exciting for pupils who had already learned the topic outside school (see ap.6.2.9.5th).

Practical work was, on the other hand, perceived to have several disadvantages. First, it was perceived as inappropriate for learning abstract mathematical concepts, the need for which increased as pupils proceeded through the grades. Five 5th grade teachers (25%) and three 8th grade teachers (25%) pointed this out. One 5th grade teacher mentioned that topics which could not be taught with concrete materials increased in 5th grade, especially in relation to number (ap.6.2.10.5th). Two teachers of each grade, i.e. 10% of 5th grade teachers and 17% of 8th grade teachers believed that the construction of abstract concepts needed training, and employing practical activities might reduce the effects of such training (see ap.6.2.11.5th; ap.6.2.12.8th). Secondly, some teachers suspected that *Practical work* might not promote pupils' understanding of the curriculum effectively. Four 5th grade teachers (20%) and two 8th grade teachers (17%) expressed this view. Some suspected that it might confuse pupils if teachers could not provide appropriate materials or give support effectively, or if pupils were unaccustomed to learning mathematics by this method (ap.6.2.13.5th). Some teachers mentioned that this teaching method was new and not all teachers could adopt it confidently. The uncertainty of some teachers might prevent other teachers from adopting this teaching method, because of the need to maintain equality between classes (ap.6.2.14.8th). Some believed practical activities might make classes fun but without any benefit to pupils' mathematics competencies. Learning mathematics through such activities might then become a negative experience (ap.6.2.15.5th). One 8th grade teacher commented that learning mathematics through activities did not necessarily link to improved attainment, because pupils might not be able to transfer what they learned through activities to other problems (ap.6.2.16.8th). Fun-based lessons were also believed to have a negative effect on learning mathematics through other methods, which might then seem less enjoyable to the pupils. One 5th grade teacher mentioned that pupils might come to dislike listening to abstract explanations or avoid practice exercises after fun-based lessons (ap.6.2.17.5th).

Thirdly, adopting practical activities frequently was difficult because of the restrictions of the pressured curriculum in limited class time. Three 5th grade teachers (15%) and three 8th grade teachers (25%) raised this issue. One 5th grade teacher mentioned that securing the time for mastering fundamental knowledge and skills would be the first consideration over making classes fun by using practical activities (ap.6.2.18.5th). Lastly, two 5th grade teachers (10%) indicated that not all children were interested in learning mathematics through practical activities. Some teachers believed that pupils might experience difficulties with practical activities, irrespective of their mathematics attainments. One 5th grade teacher mentioned that good mathematics performers sometimes showed difficulty in learning mathematics through activities, due to unfamiliarity with the approach or being poor at learning in a group (ap.6.2.19.5th).

Using a computer

Four advantages of using a computer in mathematics classes emerged. First, it was perceived to promote pupils' understanding of the curriculum through the visual sense; five 5th grade teachers (25%) and two 8th grade teachers (17%) mentioned this. Children could draw shapes more accurately, precisely and easily with a computer than by hand (ap.6.2.20.5th). Secondly, it promoted pupils' affective attitudes such as interest, enjoyment and motivation (ap.6.2.21.8th); this was raised by three 5th grade teachers (15%) and three 8th grade teachers (25%). Thirdly, one teacher from each age group mentioned that using a computer, such as CAI (Computer-assisted instruction) programmes, could meet pupils' individual needs and preferences (ap.6.2.22.8th). Lastly, two 8th grade teachers (17%) pointed out that the popularisation of the adoption of computers in mathematics classes might enable the widening of the curriculum, to include, for example, things which traditional teaching methods could not achieve (ap.6.2.23.8th).

The most distinctive disadvantage of using a computer in mathematics classes was that it did not normally involve interaction either with the teacher or peers. Two 5th grade teachers (10%) and two 8th grade teachers (17%) said that they were uncertain about the extent to which using computers, which lacked teacher-pupil or between-pupil interaction, could promote pupils' cognitive development. They asked: Can learning mathematics individually through using a computer programme promote pupils' understanding and mathematical ideas more effectively than interactive methods? One 8th grade teacher suggested that secure interactions between teacher and pupils, and between pupils, must be more effective in developing pupils' mathematical ideas than CAI (ap.6.2.24.8th).

Secondly, not all of the pupils would be interested in using a computer in mathematics classes; two 5th grade teachers (10%) and two 8th grade teachers (17%) referred to this. Some teachers also believed that pupils might be interested in operating computers but not in learning mathematics through using a computer (ap.6.2.25.8th). Thirdly, both teachers and pupils might be unfamiliar with using a computer. Five 5th grade teachers (25%) and two 8th grade teachers (17%) indicated that some pupils were unfamiliar with such use, while three 5th grade teachers (15%) and one 8th grade teacher (8%) indicated that some teachers were not familiar with teaching mathematics by using computers. One 5th grade teacher indicated that using computers might impose on teachers another duty, the acquisition of knowledge and skills about teaching mathematics through using computers (ap.6.2.26.5th). Lastly, eight 5th grade teachers (45%) and four 8th grade teachers (33%) mentioned that using computers in mathematics lessons was difficult practically, because pupils would have to share them. In addition, computer hardware dates quickly and school budgets cannot afford to change them. Teachers mentioned that appropriate software programmes to use in mathematics classes had not been developed (ap.6.2.27.5th). However, large differences existed between schools. Some had enough computers and other schools did not. Perceptions of available software programmes for mathematics classes also seemed to vary from one teacher to another (see ap.6.2.28.8th).

Reading a textbook

Most teachers of both age groups thought that reading a textbook in mathematics classes could promote pupils' understanding of the content. 5th grade teachers were overall much more likely to support the effectiveness of learning mathematics by reading a textbook than 8th grade teachers. Three main ways of using textbooks were raised. First, some teachers believed that reading a textbook could be used as the main resource in mathematics lessons; ten 5th grade teachers (45%) and two 8th grade teachers (17%) mentioned that they planned lessons using the textbook. These teachers believed that textbooks written by specialists were effective in promoting pupils' understanding and could be relied on. 5th grade teachers appreciated the well-organised content, and selected examples in textbooks for teaching mathematics in a whole-class session (ap.6.2.29.5th), while 8th grade teachers considered that starting lessons with a textbook would facilitate pupils' individualised learning (ap.6.2.30.8th). Secondly, some teachers thought that pupils could remind themselves of procedures through referring to a textbook. This would make pupils feel secure (ap.6.2.31.5th). Three 5th grade teachers (15%) and three 8th grade teachers (25%) pointed out this use. Thirdly, some teachers thought that pupils could confirm from the textbook findings obtained through exploratory learning; six 5th grade teachers (30%) and one 8th grade teacher (8%) expressed this view. These teachers did not plan lessons around the textbook. Instead, these teachers used an exploratory learning method, with discussion, and after such exploration, used the textbook to confirm the appropriateness of findings and understanding through checking with the formulae written in textbooks (ap.6.2.32.5th). An additional advantage was, as two 5th grade teachers (10%) mentioned, that using the textbook as the main resource in mathematics classes released teachers from preparation of materials and let them manage their time better. One 5th grade teacher mentioned that she preferred to use time for individual support rather than preparing extra teaching materials (ap.6.2.33.5th).

Five 5th grade teachers (25%) and five 8th grade teachers (42%) indicated that textbooks were sometimes difficult for pupils to understand. These teachers considered that some children had not developed sufficient vocabulary or comprehension competencies to understand the textbooks, while the textbooks were not appropriate for pupils to learn independently. For instance, they did not contain detailed explanations. One 5th grade teacher said it was necessary to explain the content of the textbook in plain language to promote pupils' understanding (ap.6.2.34.5th). Similarly, many teachers of 8th graders thought that learning mathematics by reading a textbook, which was supposed to be used with the teacher's guidance, was not easy for the pupils by themselves (ap.6.2.35.8th). In contradiction to this view, six 5th grade teachers (30%) and two 8th grade teachers (17%) mentioned that the mathematics textbook contained too much explanation, which might hinder pupils from thinking through the problem by themselves. These teachers thought that pupils might rely on memorising formulae or procedures without thinking of the principles underlying each formula or whether the procedures were valid (ap.6.2.36.5th). Many teachers, especially at 5th grade, used textbooks to encourage pupils to confirm understanding obtained through exploratory learning, in order to avoid methods relying on formulae and procedures written in the textbook, as described above (ap.6.2.37.5th). Five 5th grade teachers (25%) thought that reading textbooks was not an enjoyable way to learn mathematics for the pupils, because of the monotonous description and unfamiliar topics presented in them (ap.6.2.38.5th).

Teacher explanation

About a quarter of teachers of both grades perceived that the advantage of teacher explanation in mathematics classes lay in its effectiveness in promoting pupils' understanding; five 5th grade teachers (25%) and three 8th grade teachers (25%) stressed this. They believed that teachers could convey knowledge and skills to the pupils accurately, avoiding pupil confusion, which might occur when learning mathematics by exploratory methods (ap.6.2.39.5th). Secondly, some teachers mentioned that the advantage of teacher explanation was that teacher-pupil interaction could result in the promotion of pupils' positive affective attitudes towards mathematics learning; four 5th grade teachers (20%) and two 8th grade teachers (17%) stressed this point. These teachers believed that improving pupils' understanding of the curriculum through teacher-pupil interaction promoted pupils' enjoyment and motivation to learn mathematics (ap.6.2.40.8th). Thirdly, some teachers mentioned that teacher-pupil interaction could give pupils the opportunity of receiving approval; three 5th grade teachers (15%) and two 8th grade teachers (17%) raised this issue. These teachers suggested that the experience of receiving approval in class could promote pupils' confidence, sense of security and motivation. Teachers believed that this was especially the case for pupils who were not good at mathematics or who might not be able to arrive at a correct conclusion by themselves (ap.6.2.41.5th; ap.6.2.42.8th). Teachers believed that the extent to which teachers could promote pupils' positive affective attitudes towards mathematics learning through interaction depended on the extent to which teachers prepared the questions, which made pupils feel secure in giving answers. For instance, teachers of both age groups said that it was necessary to:

- Slow down the pace of lessons so that all the pupils kept up;
- Make the questions clear so that the pupils could understand what they were being asked;
- Avoid requiring pupils to reach conclusions directly, instead leading pupils to reach a conclusion gradually through small steps and a series of questions;
- Give appropriate levels of questions to individuals.

One 5th grade teacher mentioned that such considerations were more necessary for pupils who were not good at mathematics (ap.6.2.43.5th). Other teachers thought that managing classroom ethos, to ensure their pupils valued approval from each other, was important in promoting their positive affective attitudes towards mathematics. Teachers tried to avoid making pupils nervous about making mistakes by telling them that they could learn from making mistakes and analysing peers' mistakes. They also tried to put the emphasis on bringing out pupils' ideas rather than seeking the right answer directly (ap.6.2.44.5th).

Teachers pointed out different disadvantages of this teaching method according to their teaching grade. Two 5th grade teachers (10%) suspected that too much emphasis on explanation from the teacher might reduce the opportunities for encouraging pupils' autonomous learning. As a result, pupils' mathematical creativity would not be cultivated, and competencies and attitudes deriving from autonomous learning could not be developed (ap.6.2.45.5th). Three 8th grade teachers (25%) mentioned that delivering an appropriate level of explanation in mathematics classes was not easy because of the large distribution of pupils' attainment which existed within a class. They doubted whether this teaching method could retain the motivation of both high and low achievers together (ap.6.2.46.8th).

Individual learning

Teachers perceived the advantages of individualised teaching methods in terms of meeting pupils' individual needs. Many teachers believed that individualised teaching methods could provide pupils with the opportunity to learn mathematics according to their need; eight 5th grade teachers (40%) and seven 8th grade teachers (58%) stressed this. Teachers believed that pupils could learn mathematics in relation to their prior knowledge, pace of learning, learning goals, perceptions of own competence, level of practice and willingness to accept the challenge of difficult problems in individual sessions (ap.6.2.47.8th). Many teachers stressed that individualised teaching methods allowed teachers to provide support according to pupils' needs (ap.6.2.48.5th); ten 5th grade teachers (50%) and eight 8th grade teachers (67%) expressed this view. Of these, six 5th grade teachers (30%) and three 8th grade teachers (25%) mentioned that they attempted to support pupils who needed it. Teachers of both age groups thought that at least one third of pupils needed individual support. Teachers' support was centred on particular pupils (see ap.6.2.49.5th; ap.6.2.50.8th).

The two main advantages of individualised teaching methods emerged. First, six 5th grade teachers (30%) and five 8th grade teachers (42%) mentioned that doing exercises individually enabled them to identify the extent to which an individual pupil had mastered the content. Both teachers and pupils could identify which problems the pupils had not mastered through doing exercises, and the problems which they had not yet mastered could be practised (ap.6.2.51.5th). The other advantage of learning mathematics individually was that pupils could consolidate their mastery of the curriculum through doing exercises (ap.6.2.52.5th); five 5th grade teachers (25%) and three 8th grade teachers (25%) raised this issue.

However, many 5th grade teachers drew attention to the disadvantages of individualised teaching methods. First, individualised teaching methods reduced interaction with peers. Three 5th grade teachers (15%) believed that too much adoption of individual learning sessions would reduce the opportunities for mutual growth among the pupils, which whole-class teaching could achieve. These teachers tried to incorporate mutual learning through doing exercises (ap.6.2.53.5th). Secondly, seven 5th grade teachers (35%) worried that the provision of tasks according to individual attainment might have a negative impact on the affective attitudes of low achievers (ap.6.2.54.5th).

Discussion

Many teachers stressed that the advantage of whole-class discussion was that it could develop pupils' mathematical concepts through the sharing of views with peers under the teacher's guidance; ten 5th grade teachers (50%) and five 8th grade teachers (42%) mentioned this. Teachers expected pupils to develop competencies through finding various solutions to one problem and selecting the most effective solution from several alternatives (ap.6.2.55.8th). One 8th grade teacher mentioned that discussion would be the most effective teaching method to cultivate such competencies (ap.6.2.56.8th). A 5th grade teacher mentioned that this teaching method was especially effective for learning about shape (ap.6.2.57.5th).

The advantages of group discussion in mathematics classes were pointed out in relation to the effects on pupils' cognitive and personal development. Six 5th grade teachers (30%) and two 8th grade teachers (17%) mentioned that group discussion, which enabled pupils to learn mathematics with a small number of peers, could build closer interactions between pupils than whole-class discussion, and in turn, promote pupils' understanding. Such interaction was perceived as beneficial for both high and low achievers. Teachers thought that higher achievers could deepen their understanding through the process of explaining the content to other members, through thinking through the justification for the solution and seeking ways to explain their solution to other members in plain language. One 5th grade teacher mentioned that this process would facilitate mathematical development of those higher achievers who tended to rely on the formula and procedure (ap.6.2.58.5th). Teachers also perceived that learning through peer explanation might be easier than by teacher explanation for pupils who were poor at mathematics. Teachers perceived that children might feel able to ask their peers to clarify their uncertainty, and in turn, promote not only their understanding but also their positive affective attitudes such as enjoyment, motivation and a sense of security (ap.6.2.59.5th). Five 5th grade teachers (25%) mentioned that pupils learned to build good relationships with peers through taking part in discussion in a group. 5th grade teachers who valued children's personal development particularly supported this view (ap.6.2.60.5th).

Some teachers judged that discussion had disadvantages. Six 5th grade teachers (25%) suspected that the adoption of whole-class discussion in mathematics classes would be beneficial for only a limited numbers of pupils, who felt able to put forward their views, although the teachers attempted to encourage all of the pupils to contribute (ap.6.2.61.5th). Pupils might feel more comfortable about raising their views in a small group rather than in front of the whole class, and would also have more frequent opportunities to raise their views (ap.6.2.62.5th). Four 5th grade teachers (20%) and two 8th grade teachers (17%) pointed this out. However, four 5th grade teachers (20%) and three 8th grade teachers (25%) doubted the extent to which pupils could profitably share views with peers in a group. One 5th grade teacher mentioned that dividing pupils into groups so that as many pupils as possible felt able to raise their views was difficult (ap.6.2.63.5th). Some teachers perceived that pupils' competencies to share views with their peers in a group had not always developed, even by 8th grade (ap.6.2.64.8th). Four 5th grade teachers (20%) and two 8th grade teachers (17%) indicated that teachers' supervision would not be available to each group all the time. One 5th grade teacher stressed that teachers would be unable to take up pupils' good ideas in the whole class (ap.6.2.65.5th). One 8th grade teacher mentioned that teachers felt anxious about whether the curriculum could be covered comprehensively for each pupil through discussion (ap.6.2.66.8th). Three 5th grade teachers (15%) mentioned that learning mathematics in a group might hinder individual thinking, especially of the low achievers, while a 5th grade teacher mentioned that individual learning would be more effective than group learning in giving pupils the opportunity to think and find out the solutions independently (ap.6.2.67.5th). Time constraints because of the heavy curriculum were perceived as a hindrance to the adoption of discussion in mathematics classes at 8th grade (ap.6.2.68.8th). This was raised by three 8th grade teachers (25%).

Summary of 6.2

Teachers perceived that each teaching method had particular advantages and disadvantages. Each method was seen to promote pupils' cognitive development, such as understanding of the curriculum and of mathematical concepts, in a different way. Similarly, they perceived that each teaching method affected pupils' positive affective attitudes differently. Teachers' views of each method were very divergent. While some teachers believed that a particular method could promote pupils' cognitive development such as understanding of the curriculum content or of mathematical concepts, others doubted its effectiveness. Some teachers believed that a particular teaching method could work on pupils' affective attitudes positively; others suggested it might have negative effects.

Teachers' questioning of pupils in a whole class session and class discussion were perceived to maintain teacher-pupil and between-pupil interactions; these teaching methods were less able to cater for individual needs. Using a computer and individual learning were perceived to satisfy individual needs, but interactions were not guaranteed by these methods. Group discussion was perceived to maintain close peer interaction, but guidance from the teacher to each group was estimated to be limited. Teachers believed that reading a textbook, teacher explanation and individual learning overall promoted pupils' cognitive development, and they expressed confidence in helping pupils with learning mathematics through these teaching methods, but they thought that these teaching methods might affect pupils' affective attitudes negatively. Teachers believed that newer teaching methods, such as practical activities and using a computer, could positively promote pupils' affective attitudes, especially an interest in mathematics learning. However, they doubted the effectiveness of these methods in developing pupils' mathematical thinking and competence. Some teachers did not have confidence in their own teaching skills in relation to these methods. They also reported a lack of school resources. They doubted whether all children would prefer these teaching methods, and felt difficulties in adopting these new teaching methods due to time constraints, especially at 8^{th} grade. Some teachers adopted several teaching methods in parallel in mathematics classes. For example, many 5^{th} grade teachers used textbooks to confirm understanding obtained through exploratory learning in order to avoid relying totally on formulae and procedures in the textbook and so develop pupils' mathematics thinking. Teachers also tried to take account of individual needs in whole-class sessions.

Some teaching methods were perceived differently in terms of advantages and disadvantages according to age group. 5^{th} grade teachers mentioned the advantages of *Practical work* and *Group discussion* more than 8^{th} grade teachers. They believed that these teaching methods catered for pupils' affective attitudes such as enjoyment, positive and autonomous learning. They also believed that pupils could learn how to relate mathematics to events in everyday life and communicate with peers through learning mathematics through these methods. 8^{th} grade teachers valued individual learning, which satisfied individual needs, while many 5^{th} grade teachers worried about the negative effects of individual learning with differentiated materials on the affective attitudes of lower achievers.

Table 6.1: Teachers' views of advantages and disadvantages of each teaching method

Practical Work	• It promotes pupils' understanding of the curriculum (5th 40%; 8th 25%). • It develops pupils' mathematical ideas (5th 35%; 8th 25%). • It promotes pupils' interests in mathematics learning (5th 15%; 8th 17%). • It links pupils' mathematics classes and everyday life (5th 25%). • It encourages a wide range of pupils' positive involvement (5th 15%).
	• It cannot develop pupils' abstract concepts (5th 25%; 8th 25%). • It cannot promote pupils' understanding effectively (5th 20%; 8th 17%). • It is difficult to adopt this method due to time constraint (5th 15%; 8th 25%). • Not all of the pupils are interested in this method (5th 10%).
Using a computer	• It promotes pupils' understanding visually (5th 25%; 8th 17%). • It promotes pupils' interest, enjoyment and motivation (5th 15%; 8th 25%). • It meets pupils' individual needs (5th 5%; 8th 8%). • It is applicable to a wider curriculum (8th 17%).
	• It lacks teacher-pupil and pupil-pupil interaction (5th 10%; 8th 17%). • Not all of the pupils are interested in this method (5th 10%; 8th 17%). • Pupils are unfamiliar with using a computer (5th 25%; 8th 17%). • Teachers do not have enough teaching skills on CAI (5th 15%; 8th 8%). • It is difficult to adopt this method due to lack of resources (5th 45%; 8th 33%).
Reading a textbook	• Teachers can use it as the main resource for lessons (5th 45%; 8th 17%). • Pupils can remind themselves about procedures (5th 15%; 8th 25%). • Pupils can confirm the findings of exploratory learning (5th 30%; 8th 8%). • It releases teachers from preparation of materials (5th 10%).
	• Textbooks are difficult for pupils to understand (5th 25%; 8th 42%). • It hinders pupils' independent thinking (5th 30%; 8th 17%). • Reading a textbook is not enjoyable (5th 25%).
Teacher explanation	• It promotes pupils' understanding of the curriculum (5th 25%; 8th 25%). • Interactions promote pupils' affective attitudes (5th 20%; 8th 17%). • It gives pupils opportunities of being approved (5th 15%; 8th 17%).
	• It reduces the opportunities of pupils' autonomous learning (5th 10%). • It cannot satisfy pupils' individual needs (8th 25%).
Individual learning	• Pupils can learn according to individual needs (5th 40%; 8th 58%). • Teachers can meet individual needs, especially for low achievers (5th 50%; 8th 67%). • It clarifies pupil's mastery level (5th 30%; 8th 42%). • It consolidates pupils' mastery (5th 25%; 8th 25%).
	• It lacks interaction with peers (5th 15%). • It works on low achievers' affective attitudes negatively (5th 35%).
Whole-class discussion	• It develops pupils' mathematical concepts through interaction (5th 50%; 8th 42%).
	• It is beneficial only for pupils feeling able to put forward their views (5th 25%).
Group discussion	• Closer interaction promotes pupils' understanding (5th 30%; 8th 17%). • Pupils learn how to communicate with peers (5th 25%). • Pupils feel more able to raise views than in a whole-class (5th 20%; 8th 17%).
	• It cannot develop pupils' mathematical concepts effectively (5th 20%; 8th 25%). • Teachers' supervision might not be available to each group (5th 20%; 8th 17%). • It may hinder pupils' individual thinking (5th 15%). • It is difficult to adopt this method due to time constraint (8th 25%).

6.3: Teachers' perceptions of adopting various teaching methods in mathematics classes

Teachers pointed out several reasons for adopting different teaching methods in mathematics classes. First, adopting a range of methods was perceived as beneficial in promoting pupils' understanding of the learning content and developing their mathematical ideas; nine 5th grade teachers (45%) and three 8th grade teachers (25%) gave this reason. Many teachers mentioned that the teaching methods suitable for the topics of 'number' and of 'shape' were different (ap.6.3.1.8th). Some teachers thought that suitable teaching methods differed according to the stage of pupils' understanding, whether introductory, middle or advanced. A 5th grade teacher suggested that teaching methods matched to pupils' understanding levels would facilitate their full involvement in activities (ap.6.3.2.5th). Some teachers thought that explaining a problem by using various teaching methods could be more effective than using only a single teaching method in promoting pupils' understanding of the content. One 5th grade teacher mentioned that this was especially important for pupils who were not good at mathematics (ap.6.3.3.5th). One 8th grade teacher suggested that dealing with topics through various teaching methods would be necessary where the pupils were unfamiliar with the material (ap.6.3.4.8th).

Secondly, the advantage of adopting various teaching methods was seen in relation to the difficulty of selecting a particular teaching method which is most effective. Eight 5th grade teachers (40%) and two 8th grade teachers (17%) put forward this view. These teachers thought that it might be difficult for pupils to define which teaching method was suitable, in addition, pupils' preference for teaching methods might change according to their experience. Teachers thought that pupils would come to like a method as they became accustomed to it and had positive experiences, such as receiving approval from others and feeling they had progressed with that method (ap.6.3.5.5th; ap.6.3.6 for 8th).

There were several reasons for adopting a range of methods which only 5th grade teachers pointed out. First, because doing so was perceived to promote and maintain pupils' positive affective attitudes towards mathematics learning; eight 5th grade teachers (40%) raised this issue.

Adopting various teaching methods across classes (ap.6.3.7.5th) and in one class session (ap.6.3.8.5th) was perceived to avoid monotonous lessons and maintain pupils' attention and interest. Secondly, adopting various teaching methods was perceived as satisfying individual differences according to prior knowledge, learning speed (ap.6.3.9.5th), interests and preferred learning styles (ap.6.3.10.5th); eight 5th grade teachers (40%) acknowledged this. Adopting various teaching methods was also expected to interest pupils who had already mastered the textbook content outside school, and therefore would not be interested in conventional lessons (ap.6.3.11.5th). Thirdly, nine 5th grade teachers (45%) said that employing various teaching methods was important for promoting pupils' personal development. Five of these teachers thought that the combination of both learning individually and through interaction was indispensable for promoting pupils' personal development (ap.6.3.12.5th). Three of these teachers mentioned that the adoption of various teaching methods could cultivate a wide range of competencies in pupils (ap.6.3.13.5th). Three of these teachers suggested that enabling pupils to realise the advantages of various learning methods would help them outside school. One 5th grade teacher suggested that pupils' experiences of various learning methods would help them to find problem solutions (ap.6.3.14.5th).

Summary of 6.3

Table 6.2: Teachers' views of advantages of adopting various teaching methods in mathematics classes

	5th grade teachers	8th grade teachers
It promotes pupils' cognitive development.	N=9, 45%	N=3, 25%
Selecting a particular teaching method is difficult.	N=8, 40%	N=2, 17%
It promotes pupils' positive affective attitudes.	N=8, 40%	N=0
It satisfies individual needs.	N=8, 40%	N=0
It promotes pupils' personal development.	N=9, 45%	N=0

Many 5th grade teachers thought that adopting a variety of teaching methods in mathematics classes was important, and did so as a part of their practice. Fewer teachers supported the necessity of adopting various teaching methods at 8th grade, although no one expressed disagreement about this practice, except for its impracticability due to time constraints. This supports the findings from the questionnaire survey whereby teacher explanation, asking pupils questions and providing individualised work and help were the main methods adopted in mathematics classes at

8th grade. Teachers of both age groups pointed out that adopting various teaching methods was beneficial in promoting pupils' cognitive development, especially in relation to unfamiliar topics. They also pointed out that selecting the most effective teaching method was difficult. Three other reasons given for adopting a range of teaching methods were raised by 5th grade teachers. Adoption of different teaching methods across classes or within one class period might promote and maintain interest; address the problems of individuality in a large class and cultivate pupils' personal development, in a wide range of competencies.

6.4: Summary of Chapter 6

Many 5th grade teachers perceived that adopting a wide range of teaching methods in mathematics classes was beneficial for pupils' cognitive, affective and personal development. Overall, 5th grade teachers cared about pupils' positive affective attitudes towards mathematics learning and about the development of personality, and disliked pupils putting too much emphasis on observable learning performance. For this reason, they adopted practical work and group discussion more than 8th grade teachers. Many 5th grade teachers attempted to satisfy individual needs by adopting various teaching methods in a whole-class session rather than providing pupils with differentiated materials. Some 8th grade teachers agreed that adopting various teaching methods in mathematics classes was beneficial for promoting pupils' positive attitudes. However, they focused more on pupils' cognitive development and on satisfying individual needs, although they perceived that pupils' positive affective attitudes, especially motivation and sense of progress, were related to improving performance. Catering for pupils' enjoyment and sense of security was less emphasised, although pupils' concerns about their performance were sympathetically accepted. In teaching, they normally gave explanations, asked pupils questions and helped pupils with individualised work. They were reluctant to adopt new teaching methods because of the heavily loaded curriculum.

Many 5th grade teachers and some 8th grade teachers indicated that they adopted a variety of teaching methods in mathematics classes because selecting a particular teaching method was difficult. They perceived that each teaching method had distinctive advantages and drawbacks. There was no consensus among teachers regarding the effectiveness of a particular teaching method for pupils' cognitive and affective development. Teachers also believed that pupils' preferences for teaching methods were diverse. For 5th grade teachers who valued pupils' development more broadly, the need for mixed methods was acknowledged and acted upon.

CHAPTER 7: TEACHERS' AND PUPILS' PERCEPTIONS OF PUPILS' SELF, MOTIVATIONAL ORIENTATION AND CLASSROOM ETHOS

This chapter explores teachers' and pupils' perceptions of pupils' self concept, attributions of mathematics performance, classroom ethos and goal orientation in relation to pupils' affective attitudes towards mathematics as reflected in their perceptions of different teaching methods. These factors were raised in the literature as affecting pupils' affective attitudes towards mathematics learning.

7.1: Pupils' self-concept, their mathematics self-concept and teachers' attempts to enhance them

Pupils' perceptions

General self-concept

The general-self scales of SDQ-I and SDQ-II were adopted to measure the self-concept of 5th and 8th graders, respectively. Marsh (1990) explains that the general-self scale in both SDQ-I and SDQ-II measures the child's self-worth, self-confidence and self-satisfaction. However, the number of statements contained in SDQ-I and SDQ-II are different. If 5th graders select the highest point 5 for all eight questions on the scale, they get a score of 40. If 8th graders express their absolute agreement for statements supporting a high self-concept for all ten questions, they get 50.

The mean scores of individual statements on the general-self scale of 5th graders varied between 2.75 and 3.58, the overall mean was 3.09. The mean scores of the general-self scale of 8th graders varied between 2.64 and 4.11; the overall mean was 3.21. The statement where 8th graders scored 4.11 was 'If I really try I can do almost anything I want to do.' 77% of 8th graders expressed absolute agreement or agreement with this statement. The standard deviation of each statement was, overall, greater than 1.0 at both grades. Therefore, there were wide individual differences in general self-concepts at both grades. The total mean score of 5th graders was 24.76 (SD= 5.57), the total mean score of 8th graders was 32.09 (SD=6.20).

The marks were converted into standardised z scores to enable comparison of ratings between the pupils at 5th and 8th grade. Comparison of the z scores of the general-self scale of both grades were not statistically significantly different ($t=.000$, $df=3522$, $p>.05$).

Mathematics self-concept

The mathematics self-concept scales of SDQ-I and SDQ-II were adopted to measure the mathematics self-concept of 5th and 8th graders, respectively. Marsh (1990) explained that the mathematics scale measured the child's self-concept regarding his or her ability, enjoyment, and interest in mathematics. If 5th graders selected the highest point 5 for all eight questions on the scale, they would get a score of 40. If 8th graders expressed their absolute agreement for statements supporting a high self-concept for all ten questions, they would get 50.

The mean score for the mathematics scale for 5th graders varied between 2.82 and 3.16, the overall mean being 3.00. For 8th graders the scores varied between 2.12 and 3.51. The overall mean was 2.71. The standard deviation was greater than 1.0 at both grades. The total mean score of 5th graders was 24.01 ($SD=8.38$). The total mean score of 8th graders was 27.07 ($SD=8.94$). Z scores of the mathematics scale at both grades were not statistically significantly different ($t=1.158$, $df=2391$, $p>.05$).

Perceptions of being good or poor at mathematics

Pupils' perceptions of being good or poor at mathematics were measured by a five-point rating scale with 5 for very good and 1 for very poor. The mean score of 5th graders was 3.27 ($SD=.96$), while the mean score of 8th graders was 2.70 ($SD=1.02$). Overall, 5th graders reported that they were average at mathematics, while 8th graders reported that they were poor at mathematics. This difference was statistically significant ($t=17.122$, $df=3305.06$, $p<.01$).

Pupils' mathematics self-concept and their perceptions of themselves as good or poor at mathematics were highly correlated at both grades (see Table 7.1.1), although pupils' perceptions of themselves as being good or poor at mathematics might not reflect actual achievement or teachers' assessment. Pupils' general self-concept was correlated with their mathematics self-concept and the extent to which they perceived themselves good or poor at mathematics respectively at both grades, although the correlation was not high (see Table 7.1.1). In the literature, global self-esteem and self-perceptions of competence are usually correlated positively. For instance, Marsh (1990) reported a correlation between mathematics self-concept and general self-concept of .19 for SDQ-I and .14 for SDQ-II. Compared with these results, much higher correlations were found among the Japanese students (see Table 7.1.1).

Table 7.1.1: Correlations between pupils' self-concept, mathematics self-concept and pupils' perceptions of being good or poor at mathematics

	5th graders			8th graders		
	N	r	p	N	r	p
Mathematics self-concept x Good at Maths	1437	.713	.000	2094	.675	.000
General self-concept x Mathematics self-concept	1410	.421	.000	2012	.324	.000
General self-concept x Good at Maths	1450	.397	.000	2074	.345	.000

Pupils' general self-concept, mathematics self-concept, perceived mathematics performance and perceptions of teaching methods

This section examines the assumption that pupils' general self-concept, mathematics self-concept and perceived mathematics performance affect their perceptions of teaching methods. 5th and 8th graders were divided into two groups using their scores on general self-concept, and mathematics self-concept. The difference in perceptions of teaching methods of the two groups was compared using Independent t-tests. 5th graders and 8th graders were divided into three groups on the basis of their perceived mathematics performance. The difference in the perceptions of teaching methods in the three groups was compared, using analysis of variance. The details of how the groups were formed are outlined below.

General self-concept - The total mean score for general self-concept at 5th grade was 24.76 (SD=5.57, median=25). The total mean score for general self-concept at 8th grade was 32.09 (SD=6.20, median=32). The relatively large difference between the two groups was due to the different possible total scores; 40 for 5th graders and 50 for 8th graders. 5th graders were divided into those who scored at least 26 (44.7%) or below 25

(55.3%). 8th graders were divided into those who scored at least 33 (47.6%) or below 32 (52.4%).

Mathematics self-concept - The total mean score for mathematics self-concept at 5th grade was 24.01 (SD=8.38, median=24). 5th graders were divided into those who scored at least 25 (48.5%) or below 24 (51.5%). The total mean score for mathematics self-concept at 8th grade was 27.07 (SD=8.94, median=27). 8th graders were divided into those who scored at least 28 (48.3%) or below 27 (51.7%).

Perceived mathematics performance - Pupils of both grades were divided into three groups; pupils perceiving themselves as good, average or poor at mathematics, as explained in Figure 7.1.1. The percentage of pupils perceiving themselves as good, average, and poor was 37.7%, 44.8% and 17.5% at 5th grade, and 21.5%, 37.0% and 41.5% at 8th grade.

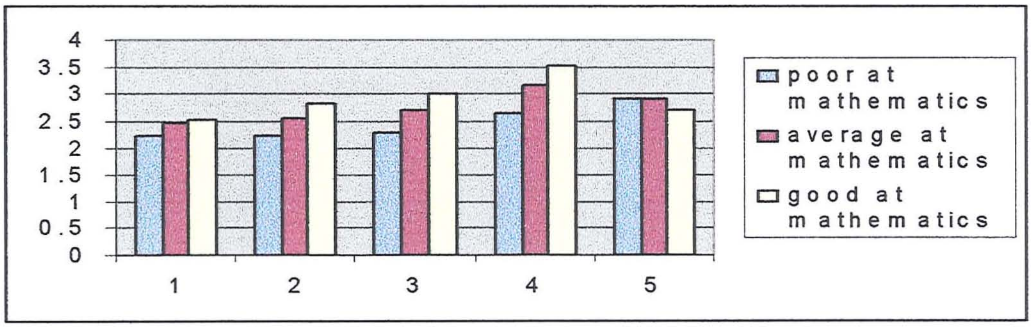
Table 7.1.2: Pupils' perceptions of the frequency of deployment of teaching methods and affective attitudes promoted by these teaching methods according to their perceptions of the self

			Enjoyment	Motivation	Sense of security	Sense of progress	Deployment
General self-concept	5th	p<.01	**PW,RT,TE, IW, WD,GD**	**PW,RT, TE, IW,IH,WD,GD**	**PW,RT, TE, IW,IH,WD,GD**	**PW,RT, TE, IW,IH,WD,GD**	**PW,RT, TE, IW,IH,WD,GD**
		Other	UC,IH,	UC	UC	UC	UC
	8th	p<.01	**TE, IW,IH, WD, GD**	**RT,TE, IW,IH, WD, GD**	**RT,TE, IW,IH, WD, GD**	**RT,TE, IW,IH,GD**	**UC,RT,TE, IW,IH,WD**
		Other	PW,UC, RT	PW,UC	PW,UC	PW,UC, WD	PW,GD
Mathematics self-concept	5th	p<.01	**PW,RT, TE, IW,IH,WD,GD**	**PW,RT, TE, IW,IH,WD,GD**	**PW,RT, TE, IW,IH,WD,GD**	**PW,RT, TE, IW,IH,WD,GD**	**RT,TE, IW,WD,GD**
		Other	UC	UC	UC	UC	PW,UC,IH
	8th	p<.01	**RT,TE, IW**	**RT,TE, IW**	**UC, RT,TE, IW**	**UC, RT,TE, IW**	**UC,TE, IW,IH**
		Other	PW,UC, IH,WD,GD	PW,UC, IH,WD,GD	PW, IH,WD,GD	PW, IH,WD,GD	PW,RT, WD,GD
Mathematics Performance	5th	p<.01	**PW,RT, TE, IW,IH,WD,GD**	**PW,RT, TE, IW,IH,WD,GD**	**PW,RT, TE, IW,IH,WD,GD**	**PW,RT, TE, IW,IH,WD,GD**	**PW,RT, TE, IW, IH, WD,GD**
		Other	UC	UC	UC	UC	UC
	8th	p<.01	**PW,UC,TE, IW,WD**	**TE, IW,IH**	**TE, IW,IH,WD**	**TE, IW,IH**	**UC,TE, IW,IH**
		Other	RT,IH,GD	PW,UC,RT WD,GD	PW,UC,RT, GD	PW,UC,RT WD,GD	PW,RT, WD,GD

NB. Teaching methods in bold are those where there were significant difference between the groups. The teaching methods in red are those where students with lower scores of factors perceive more frequent deployment and more positive affective attitudes. For full details see Appendices 7.1.1 – 7.1.6.

Table 7.1.2 shows that those with a higher general self-concept, higher mathematics self-concept and higher perceived mathematics performance, overall, perceived more frequent deployment of all of the teaching methods and more positive affective attitudes generated by different teaching methods than those in the other groups, although there were some exceptions where no significant difference was found. This was the case at both grades. For 5th graders' neither general self-concept, mathematics self-concept nor perceived mathematics performance affected their perceived frequency of deployment of *Using a computer* or the four aspects of affective attitudes promoted by this teaching method. No statistically significant difference was found in their perceptions of the extent to which enjoyment was promoted by *Individual help* according to the extent of their general self-concept. No significant difference was found in 5th graders' perceived frequency of deployment of *Practical work* and *Individual help,* according to their mathematics self-concept. 5th graders perceiving themselves as good at mathematics perceived less frequency of the deployment of *Individual help* than 5th graders perceiving themselves average or poor at mathematics, despite the fact that they were more likely to perceive that *Individual help* could promote their affective attitudes more than 5th graders perceiving themselves average or poor at mathematics (see Table 7.1.3 and Figure 7.1.1). Overall, however for 5th graders self-concept, mathematics self-concept and perceived mathematics performance had a major impact on their perceptions of the deployment, and perceived effects on attitudes of different teaching methods (See appendices 7.1.1, 7.1.3, 7.1.5)

Figure 7.1.1: Mean scores of 5th graders' affective attitudes towards mathematics learning promoted by *Individual help* and their perceptions of the frequency of deployment of *Individual help* according to their perceptions of themselves as good, average, poor at mathematics



1=Enjoyment, 2=Motivation,
3=Sense of security, 4=Sense of progress, 5=Deployment

Table 7.1.3: Mean scores and Standard Deviation of 5th graders' affective attitudes towards mathematics learning promoted by *Individual help* and the perceived frequency of deployment of *Individual help* according to perceived mathematics performance

	Enjoyment			Motivation			Security			Progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
poor	259	2.24	1.27	260	2.22	1.32	259	2.30	1.40	259	2.64	1.46	258	2.91	1.11
average	659	2.46	1.16	662	2.57	1.28	659	2.72	1.31	660	3.16	1.33	659	2.92	.95
good	554	2.52	1.29	555	2.84	1.38	555	3.00	1.37	556	3.51	1.34	555	2.70	1.08
ANOVA	F=4.841, p<.01			F=20.431, p<.01			F=23.940, p<.01			F=36.134, p<.01			F=7.532, p<.01		

8th graders' general self-concept did not affect their perceptions of the four aspects of affective attitudes as promoted by *Practical work* and *Using a computer,* enjoyment as promoted by *Reading a textbook* or sense of progress as promoted by *Whole-class discussion*. No significant differences were found in 8th graders' perceptions of the frequency of deployment of *Practical work* and *Group discussion* according to their general self-concept. Overall, there were slightly fewer differences than at 5th grade although the pattern was similar (see Appendices 7.1.2).

8th graders with higher mathematics self-concept perceived that positive affective attitudes were promoted by *Reading a textbook*, *Teacher explanation* and *Individual work* more than 8th graders with lower mathematics self-concept, although mathematics self-concept, overall, did not affect perceptions of positive attitudes as promoted by *Practical work*, *Whole-class discussion*, *Group discussion* and *Individual help*. 8th graders with lower mathematics self-concept perceived that *Using a computer* could promote their sense of security and sense of progress, although they perceived less frequent deployment of this teaching method. No significant difference was found in their perceptions of enjoyment and motivation as promoted by *Using a computer* according to their mathematics self-concept. Overall, there were fewer differences than at 5th grade (see Appendices 7.1.4).

8th graders perceiving themselves as poor at mathematics perceived less frequent deployment of *Individual work, Individual help* and *Teacher explanation* than 8th graders perceiving themselves average or good at mathematics. They also perceived that less positive affective attitudes towards mathematics learning were promoted by these teaching methods than other 8th graders, although no significant difference was found in enjoyment promoted by *Individual help.* There were few differences between the perceptions of 8th graders perceiving themselves as average and good at mathematics. 8th graders perceiving themselves poor at mathematics perceived that *Practical work,* and *Using a computer* promoted their enjoyment less and *Whole-class discussion* promoted their enjoyment and sense of security less than 8th graders perceiving themselves as good or average at mathematics. They also perceived less frequent deployment of *Using a computer*. Overall, there were fewer differences than at 5th grade (see Appendices 7.1.6).

Teachers' perceptions

Teachers were asked to rate the extent to which they attempted to enhance their pupils' self-concept and mathematics self-concept, respectively, in mathematics classes. Teachers of both age groups on average reported that they attempted to enhance pupils' general self-concept and mathematics self-concept sometimes. Although 5th grade teachers reported they attempted to enhance their pupils' self-concept and mathematics self-concept more than 8th grade teachers, this difference was not statistically significant (see Table 7.1.4).

Table 7.1.4: Mean scores and Standard Deviation of teachers' attempts to enhance pupils' general self-concept and mathematics self-concept

	5th grade teachers			8th grade teachers		
	N	M	SD	N	M	SD
General self-concept t=. 876, df=82, p>.05	43	3.40	.95	41	3.22	.88
Mathematics self-concept t=1.334, df=85, p>.05	46	3.59	.83	41	3.34	.88

There was a relatively high correlation between teachers' attempts to enhance pupils' general self-concept and their attempts to enhance pupils' mathematics self-concept, at both age groups (5th grade: r=. 706, p=. 000; 8th grade: r=. 736, p=. 000).

To further the analysis teachers were divided into two groups based on their scores on the extent to which they attempted to enhance pupils' general self-concept and pupils' mathematics self-concept. 5th grade teachers who reported attempting to enhance their pupils' general self-concept positively perceived that

- *Whole-class discussion* could promote pupils' enjoyment (t=3.292, df=41, p<. 01) and sense of security (t=4.170, df=40, p<. 01);
- *Individual help* could promote pupils' sense of progress (t=2.817, df=29.937, p<. 01) more than other 5th grade teachers,

No statistically significant difference was found in their perceptions of pupils' affective attitudes promoted by other teaching methods. No statistically significant difference was found in their perceived frequency of any teaching methods.

5th grade teachers attempting to enhance their pupils' mathematics self-concept positively perceived that

- *Individual work* could promote their pupils' enjoyment ($t=2.983$, $df=44$, $p<.01$);
- *Teacher explanation* could promote their pupils' sense of progress ($t=2.851$, $df=44$, $p<.01$) more than other 5th grade teachers.

No statistically significant difference was found in the perceptions of affective attitudes promoted by other teaching methods. No statistically significant difference was found in their perceived frequency of any teaching methods.

No statistically significant differences were found between the responses of these two groups in relation to their perceived frequency of any teaching methods or perceptions of how these promoted pupils' positive affective attitudes among the responses of 8th grade teachers.

Summary of 7.1

Pupils' general self-concept and mathematics self-concept as measured by SDQ-I and SDQ-II were similar across the two ages. A strong emphasis on effort for achievement was found in 8th graders, although pupils' perceptions of being good at mathematics deteriorated as their grades proceeded. There were strong relationships between mathematics self-concept and perceptions of being good at mathematics.

Pupils with higher general self-concept, mathematics self-concept and perceptions of mathematics performance, overall, perceived more frequent deployment of all teaching methods and more positive affective attitudes towards mathematics learning being promoted by the adoption of almost all teaching methods. This was especially so at 5th grade. At 5th grade, *Using a computer* was the only teaching method where this was not the case. 5th graders perceiving themselves as good at mathematics believed that *Individual help* was given less than other 5th graders, although they felt that this teaching method could promote their positive affective attitudes more than other 5th graders.

8th graders with higher general self-concept perceived more positive affective attitudes promoted by almost all teaching methods than 8th graders with lower general self-concept, the exceptions were *Practical work* and *Using a computer.* In contrast, 8th graders' mathematics self-concept was related to positive affect promoted by *Reading a textbook*, *Teacher explanation* and *Individual work.*

8th graders with lower mathematics self-concept perceived a higher sense of security and sense of progress promoted by *Using a computer.* They also perceived less frequent deployment of this teaching method. 8th graders' perceived mathematics performance also influenced affective attitudes promoted by certain teaching methods, in particular *Teacher explanation*, *Individual work* and *Individual help.* 8th graders with higher perceived mathematics performance perceived that *Practical work* and *Using a computer* could promote their enjoyment and *Whole-class discussion* could promote their enjoyment and sense of security.

8th graders with higher general self-concepts perceived more frequent deployment of all the teaching methods except for *Practical work* and *Group discussion*; 8th graders with higher mathematics self-concept and higher perceived mathematics performance perceived more frequent deployment of *Using a computer*, *Teacher explanation*, *Individual work* and *Individual help* but not other teaching methods. *Teacher explanation*, *Individual work* and *Individual help* were, as presented in Chapter 4, deployed very frequently in mathematics classes at 8th grade. 8th graders with lower mathematics self-concept perceiving themselves poor at mathematics perceived less time spent on all teaching methods and less positive effects of these methods on their attitudes.

Teachers reported that they only "sometimes" attempted to enhance pupils' general self-concept and mathematics self-concept. Those giving positive responses were likely to do so for both categories. The extent of 5th grade teachers' attempts to enhance their pupils' general self-concept influenced their thinking about *Whole-class discussion* and *Individual help* and how these might promote positive affect through pupil-pupil interaction and teacher-pupil interaction. In contrast, the extent to which 5th grade teachers' reported attempting to enhance their pupils' mathematics self-concept affected their perceptions of teaching methods relating to individual pupils' cognition such as *Individual work* and *Teacher explanation.* 8th grade teachers' perceptions of their pupils' positive affective attitudes did not seem to be affected by their reported attempts to enhance pupils' general self-concept and mathematics self-concept. The extent of deployment of particular teaching methods also did not seem to be affected by these attempts.

7.2: Pupils' and teachers' attribution of pupils' mathematics performance

Pupils' perceptions

In the questionnaire, both 5th and 8th graders who responded as being Very good, Good or OK at mathematics were asked to choose one alternative of six as a positive attribution of their success.

These alternatives were:

- Ability (I am clever enough to do well at Maths classes),
- Effort (I try hard to do well at Maths classes),
- Luck (It is just lucky for me to do well at Maths classes),
- Teacher support (I have enough support from the teacher in mathematics classes),
- Home support (I have enough support from my parents or juku teachers to do well),
- Easy task (Tasks and tests are easy in Maths classes).

A space was left so that pupils could write an alternative reason for their success in mathematics for 8th graders.

Approximately one third of pupils of both age groups attributed their success in mathematics learning to effort. 5th graders were more likely to attribute their success to support from others such as home support or support from the teacher in mathematics classes than 8th graders, while 8th graders were more likely to attribute their success in mathematics learning to luck than 5th graders. Few from each grade attributed their success in mathematics learning to ability or easiness of the task provided. Few 8th graders expressed attributions of their success in learning mathematics in their own words. Of those that did the attributions were 'I am interested in maths' (N=42, 3.7%), 'I learned maths a lot in my early years' (N=7, 0.6%), and the 'Learning materials are good for promoting my understanding' (N=1, 0.1%) (see Table 7.2.1).

Table 7.2.1: Percentages of pupils attributing their good or average at mathematics to the following factors

	1=Ability	2=Effort	3=Luck	4=Teacher support	5=Home Support	6=Easy Task	7=Others
5th graders	31 (2.7%)	364 (31.0%)	92 (7.9%)	269 (23.0%)	381 (32.4%)	35 (3.1%)	------------
8th graders	58 (5.1%)	411 (36.3%)	158 (13.9%)	193 (17.0%)	208 (18.4%)	47 (4.1%)	59 (5.2%)

5th and 8th graders who reported themselves as Poor or Very poor at mathematics were asked to choose one possible reason for failure from six alternatives: lack of ability, lack of effort, lack of luck, lack of teacher support, lack of home support and task difficulty. A space was left for 8th graders to write an alternative reason for being poor at mathematics. The majority of 8th graders attributed their being poor at mathematics to lack of effort. Effort-based attribution in failure was found more at 8th grade than 5th grade. 5th graders were more likely to attribute their being poor at mathematics to lack of ability. Effort-based attributions of 8th graders and ability-based attributions of 5th graders manifested among the pupils perceiving themselves poor at mathematics were greater than for pupils perceiving themselves good or average at mathematics. Slightly more than one tenth of 5th graders attributed their being poor at mathematics to task difficulty. Fewer 8th graders gave task-based attributions. Pupils from both age groups attributing their being poor at mathematics to lack of luck, lack of teacher support or lack of home support were very few. Approximately one tenth of 8th graders described their attribution of failure in their own words. Those attributions were 'I am not interested in mathematics (3.3%)', 'I often make tiny mistakes (2.7%)' 'I can't develop my understanding (1.1%)', 'I don't know how to learn mathematics effectively (0.6%)' and 'others (2.7%)' (see Table 7.2.2).

Table 7.2.2: Percentages of pupils attributing their poor at mathematics to the following factors

	Lack of Ability	Lack of Effort	Lack of Luck	Lack of Teacher Support	Lack of Home Support	Task Difficulty	Others
5th graders	88 (35.9%)	97 (39.6%)	9 (3.7%)	7 (2.9%)	10 (4.1%)	34 (13.9%)	-------------
8th graders	88 (10.8%)	487 (59.8%)	16 (2.0%)	55 (6.8%)	24 (2.9%)	58 (7.1%)	86 (10.4%)

Pupils' attribution of mathematics performance and their perceptions of teaching methods

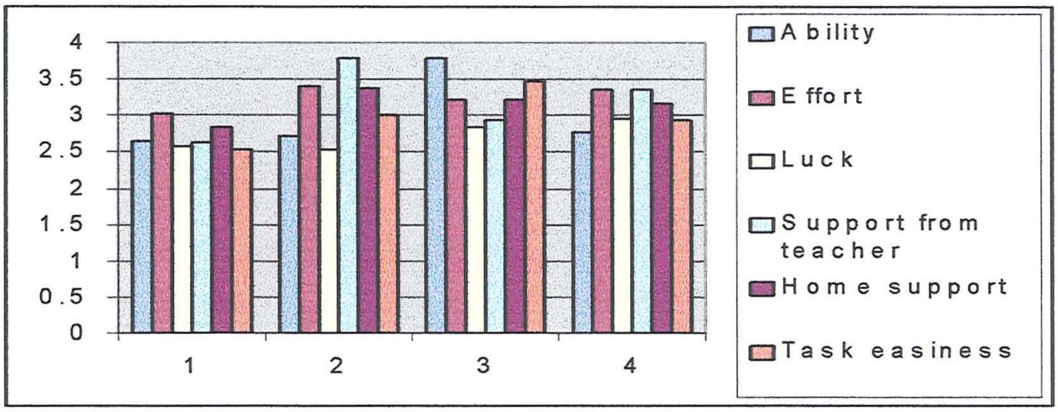
This section examines the assumption that pupils' perceived frequency of deployment of the teaching methods and their affective attitudes promoted by the teaching methods vary according to their attribution of perceived mathematics performance. In short, this assumption was supported. Pupils' attributions of their perceived mathematics performance affected their perceived frequency of deployment of different teaching methods and their affective attitudes as promoted by the different teaching methods. Overall, pupils attributing success in mathematics learning to effort and support from the teacher and pupils attributing success in mathematics learning to ability were likely to report different perceived frequencies of deployment of teaching methods and their affective attitudes as promoted by the those teaching methods.

5th graders attributing success to support from the teacher, followed by effort and home support perceived more than those attributing it to ability that *Teacher explanation* could promote the four aspects of affective attitudes. 5th graders attributing success to support from the teachers and effort perceived more than those attributing it to task easiness that motivation and sense of progress were promoted by *Whole-class discussion.* Sense of security was promoted by *Group discussion* and there was a greater frequency of perceived deployment of *Group discussion.* 5th graders attributing their success to ability perceived less that *Whole-class discussion* could promote motivation.

5th graders attributing success to ability or task easiness perceived more than those attributing it to support from the teacher that *Individual work* could promote the four aspects of affective attitudes and that this method was deployed more frequently. A similar pattern emerged in the relationship between 5th graders' attributions and their sense of security as promoted by *Individual help*. However, those attributing success to support from the teacher perceived more frequent deployment of *Individual help* than those attributing it to ability and task easiness.

5th graders attributing their success to effort or support at home perceived more than those attributing it to task easiness that *Reading a textbook* could promote their enjoyment and motivation. 5th graders attributing their success to ability or task easiness perceived more that *Practical work* could promote their sense of security and sense of progress. Those attributing success to support at home perceived less that *Practical work* could promote these aspects. 5th graders attributing their success to support from the teacher perceived more frequent deployment of *Practical work* than those attributing it to task easiness. 5th graders attributing success to luck perceived less overall that all teaching methods could promote positive affective attitudes towards mathematics learning (see e.g. Figure 7.2.1). (also see appendices Table 7.2.1~Table 7.2.5)

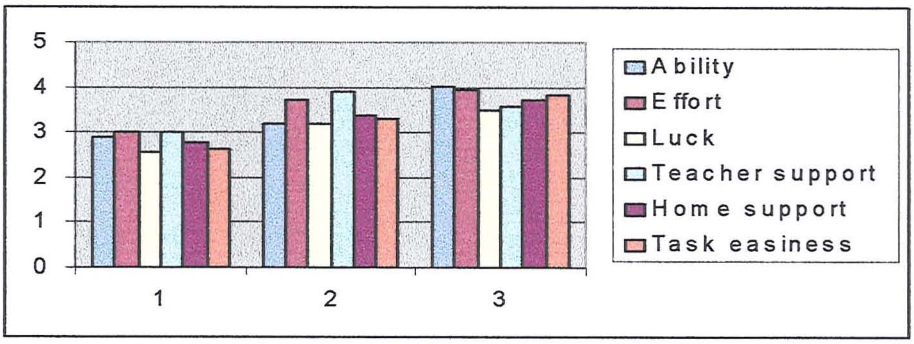
Figure 7.2.1: Mean scores of 5th graders' motivation promoted by teaching methods according to their attribution styles of success in mathematics learning



1=Reading a textbook, 2=Teacher explanation,
3=Individual work, 4=Whole-class discussion

8th graders attributing success to effort and support from the teacher perceived more than those attributing success to ability that *Teacher explanation* could promote positive affective attitudes. 8th graders attributing success to ability, effort or task easiness perceived more than those attributing it to support from the teacher that *Individual work* could promote their sense of security and sense of progress. 8th graders attributing success to effort and support from teacher perceived more than those attributing it to task easiness that *Reading a textbook* could promote their motivation, sense of security and sense of progress. 8th graders attributing success to luck overall perceived less that all teaching methods could promote positive affective attitudes towards mathematics learning (see Figure 7.2.2). (also see appendices Table 7.2.6~Table 7.2.10).

Figure 7.2.2: Mean scores of 8th graders' sense of security promoted by teaching methods according to their attribution styles of success in mathematics learning



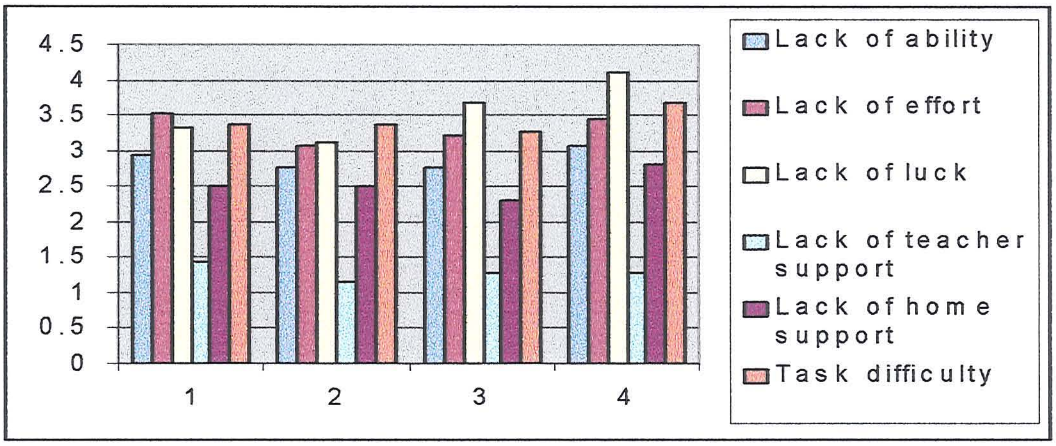
1=Reading a textbook, 2=Teacher explanation, 3=Individual work

5th graders' affective attitudes towards mathematics learning as promoted by different teaching methods, overall, did not vary according to their attribution of failure in mathematics learning. However, 5th graders attributing their failure in mathematics learning to lack of teacher support perceived that *Teacher explanation* could promote positive affective attitudes towards mathematics learning less. In contrast, 5th graders attributing their failure in mathematics learning to lack of effort, task difficulty or lack of luck perceived *Teacher explanation* more positively (Table 7.2.3 and Figure 7.2.3). 5th grader's perceptions of the frequency of deployment of each teaching method did not vary according to the way they attributed their failure (also see appendices Table 7.2.11).

Table 7.2.3: 5th graders' affective attitudes towards mathematics learning promoted by *Teacher explanation* varying according to their attribution styles of failure in mathematics learning

	Enjoyment			Motivation			Sense of security			Sense of progress		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Lack of ability	88	2.93	1.28	88	2.77	1.32	88	2.75	1.38	88	3.08	1.44
Lack of effort	97	3.53	1.25	97	3.08	1.33	97	3.23	1.34	97	3.45	1.38
Lack of luck	9	3.33	1.80	9	3.11	1.76	9	3.67	1.66	9	4.11	1.36
Lack of teacher support	7	1.43	1.13	7	1.14	.38	7	1.29	.76	7	1.29	.76
Lack of Home support	10	2.50	1.51	10	2.50	1.18	10	2.30	1.42	10	2.80	1.32
Task difficulty	34	3.38	1.28	34	3.38	1.44	34	3.26	1.38	34	3.68	1.41
ANOVA	F=5.317, p<.01			F=4.016, p<.01			F=4.535, p<.01			F=4.984, p<.01		

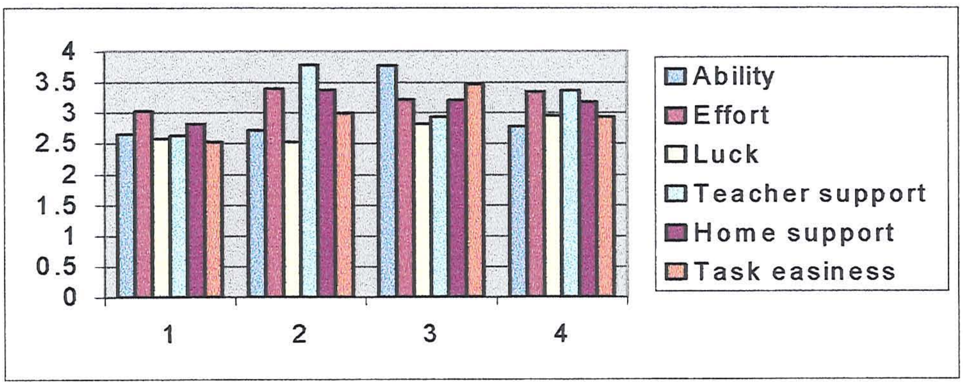
Figure 7.2.3: Mean scores of 5th graders' affective attitudes towards mathematics learning promoted by *Teacher explanation* varying according to their attribution styles of failure in mathematics learning



1=Enjoyment, 2=Motivation, 3=Sense of security, 4=Sense of progress

8th graders attributing their failure in mathematics learning to lack of teacher support perceived that *Teacher explanation* promoted their motivation and sense of progress less, while those attributing their failure in mathematics learning to lack of luck, lack of effort and task difficulty perceived more that these teaching methods promoted these aspects positively. These were the similar pattern with the findings of 5th graders. 8th graders attributing their failure in mathematics learning to lack of teacher support also perceived that *Group discussion* promoted their sense of progress less than those attributing it to other factors. 8th graders' perceptions of the frequency of deployment of each teaching method did not vary according to the way they attributed their failure (also see appendices Table 7.2.12).

Figure 7.2.4: Mean scores of 8th graders' affective attitudes towards mathematics learning promoted by *Teacher explanation* varying according to their attribution styles of failure in mathematics learning



1=Enjoyment, 2=Motivation, 3=Sense of security, 4=Sense of progress

Table 7.2.4: 8th graders' affective attitudes towards mathematics learning promoted by *Teacher explanation* and *Group discussion* varying according to their attribution styles of failure in mathematics learning

Teacher explanation	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Lack of ability	88	3.22	1.32	87	2.71	1.37	87	3.05	1.39	87	3.60	1.26	87	3.85	1.17
Lack of effort	487	3.35	1.22	**485**	**3.22**	**1.21**	482	3.41	1.20	**482**	**3.82**	**1.06**	485	3.93	1.05
Lack of luck	16	3.50	1.21	**16**	**3.56**	**1.26**	16	3.44	1.03	**16**	**4.00**	**1.16**	16	3.69	1.20
Lack of support form teacher	55	2.65	1.42	**54**	**2.48**	**1.30**	55	2.93	1.41	**55**	**3.07**	**1.29**	55	3.73	1.06
Lack of home support	24	3.38	1.31	24	3.17	1.37	24	3.38	1.31	24	3.71	1.08	24	3.96	.96
Task difficulty	58	3.21	1.28	**58**	**3.28**	**1.25**	58	3.36	1.29	**58**	**3.93**	**1.01**	58	3.64	1.12
ANOVA	F=1.512, p<1.0			F=2.293, p<. 01			F=1.257, p<1.0			F=2.470, p<. 01			F=1.277, p<. 5		

Group discussion	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Lack of ability	88	2.72	1.39	87	2.83	1.46	87	2.67	1.44	87	2.53	1.27	87	1.51	.79
Lack of effort	487	2.72	1.29	484	2.69	1.24	480	2.60	1.21	482	2.72	1.19	482	1.56	.75
Lack of luck	16	2.63	1.26	16	2.44	1.41	16	2.25	1.13	16	2.50	1.16	16	1.44	.73
Lack of support form teacher	55	2.55	1.39	55	2.55	1.36	55	2.31	1.25	**55**	**2.11**	**1.29**	55	1.35	.70
Lack of home support	24	3.08	1.35	24	2.71	1.20	24	2.88	1.19	24	2.79	.98	23	1.70	.64
Task difficulty	58	2.67	1.47	58	2.71	1.21	58	2.53	1.05	58	2.48	1.06	58	1.47	.68
ANOVA	F=1.092, p<. 5			F=. 775, p<1.0			F=1.327, p<. 5			F=2.039, p<. 01			F=1.297, p<. 5		

Teachers' perception

Teachers were asked to explain in an open question on the questionnaire why they thought some of their pupils succeeded in learning mathematics and others failed to do so. Space was given for teachers to explain the attributions of their pupils' being good or poor at mathematics separately. However, many teachers presented closely related views regarding the attributions of pupils' success and failure in mathematics learning. Teachers perceived that pupils failing in mathematics learning lacked certain characteristics, which pupils succeeding had. Teachers' attributions for pupils' being good at mathematics were broadly divided into four categories: Effort, Ability, Interest, and Competencies.

- Effort indicated pupils' positive attitudes towards learning mathematics such as concentration on learning and perseverance. Many teachers whose response was categorised into this group used the word 'effort' or 'continuous effort'.
- Ability indicated pupils' natural innate abilities. Teachers wrote, for example, 'Heredity', 'Nature', 'Native sense' here.
- Interest indicated pupils' high interest in learning mathematics. Examples included 'Fond of learning mathematics', and 'High interest in mathematics'.

- Competencies indicated pupils' high competencies in mathematics, such as comprehensive ability or high skills in computation. This contrasted with Ability which indicated natural innate capabilities, for instance, 'Individuals have different innate capacities such as 'DNA'. On the other hand, competencies indicated nurture, e.g. 'Accumulated competencies from their early years'.

The majority of teachers of both age groups (58.5% at 5th grade, 66.7% at 8th grade) attributed their pupils' being good at mathematics to effort, competencies or a combination of these elements. Teachers thought competencies in mathematics were learned based on accumulated effort as explained above. Slightly less than one tenth of teachers from both age groups gave ability-based attributions. Approximately one eighth of 5th grade teachers attributed their pupils' being good at mathematics to Interest, while only one 8th grade teacher gave this attribution (see Table 7.2.4).

Table 7.2.5: Teachers' attributions of their pupils' success in mathematics learning

	5th grade teachers (N=41)		8th grade teachers (N=36)	
	N	%	N	%
Ability	4	9.8	3	8.3
Effort	3	7.3	12	33.3
Competencies	13	31.7	11	30.6
Interest	6	14.6	1	2.8
Effort and Ability	4	9.8	5	13.9
Effort and Competencies	8	19.5	1	2.8
Interest and Competencies	2	4.9	3	8.3
Competencies and Ability	1	2.4	0	0

Summary of 7.2

There were differences in pupils' attribution style according to their age and perceived mathematics performance. Many pupils attributed their success in mathematics learning to effort, support from the teacher and support at home, irrespective of their age. For pupils with these attributional styles, *Teacher explanation* and *Reading a textbook* were favoured teaching methods, atlhough preference for *Reading a textbook* enhanced from support from home to support from the teacher as pupils proceeded through the grades. 5th graders with these attributional styles favoured *Whole-class discussion* and *Group discussion* as well. In contrast, pupils attributing success to support from the teacher disliked *Individual work* at both grades, although where 8th graders believed that one's own effort was important *Individual work* was valued.

Overall, few pupils attributed their success to ability or task easiness. For those pupils that did *Individual work* was favoured as supporting affect while *Teacher explanation* and *Reading a textbook* were not. 5th graders attributing success to task easiness favoured *Practical work*, and *Individual work* and *help* as supporting positive attitudes. 5th graders attributing success to ability or task easiness perceived that *Practical work* and *Individual help* positively promoted positive affective attitudes, although they perceived less frequent deployment of these teaching methods.

The percentage of pupils attributing their success to luck was very low. This attributional style was reported more among 8th graders than 5th graders. Those attributing their success to luck perceived less frequent deployment of all teaching methods and less positive affective attitudes promoted by them.

Many pupils perceiving themselves poor at mathematics attributed failure in mathematics learning to lack of effort; this tendency was particularly strong at 8th grade. A nearly equal percentage of younger pupils attributed failure to lack of effort or lack of ability. Attribution of failure to lack of effort or lack of ability did not seem to affect perceptions of the effects of or deployment of different teaching methods. Pupils attributing failure to lack of teacher support believed *Teacher explanation* did not promote positive attitudes at both grades.

Most teachers from both age groups gave effort-based attributions for their pupils' success. Few teachers gave ability-based attributions. Due to the small number of teacher participants and the inequality of the distributions of teacher participants according to attributional style, the relationships between teachers' perceptions of the attributional styles of their pupils' and their perceptions of the effects and deployment of different teaching methods were not examined.

7.3: Pupils' and teachers' perceptions of classroom ethos

Pupils' perceptions

Pupils' perceptions of classroom ethos at both grades were measured through Fraser's My Classroom Inventory (MCI). This Inventory consists of five domains; Satisfaction, Cohesiveness, Competitiveness, Friction and Difficulty. Each domain contains five questions. As MCI aims to investigate pupils' perceptions of classroom ethos in all classes, and this study attempted to explore pupils' perceptions of classroom ethos in mathematics classes in particular, the words "mathematics classes" were inserted into each statement.

- *Satisfaction* relates to pupils' enjoyment and happiness, in mathematics classes. Statements included 'The pupils in my Maths class enjoy their work', and 'Children seem to like this Maths class.'
- *Cohesiveness* relates to pupils' friendships in mathematics classes. Statements included 'In my Maths class everybody is my friend'.
- *Competitiveness* relates to pupils' competitiveness both in terms of speed of completion and actual outcomes, for instance, 'Children often race to see who can finish first in my Maths class', and 'Some pupils always try to do their work better than the others in my Maths class.'
- *Friction* relates to conflicts or fighting in mathematics classes. For instance, 'Children are always fighting each other in my Maths class'.
- *Difficulty* relates to pupils' difficulty in dealing with the task provided. For instance, 'In our Maths class the work is hard to do.'

The Fraser's MCI has yes/no responses, which are added to derive a total for each section. Respondents are given a score of 5 when they mention '*Yes*' to five questions in the domain, 4 when they mention 'Yes' to four questions in the domain and so on. MCI contains seven reverse statements whose scores are adjusted.

Pupils from both age groups did not report feeling great satisfaction in mathematics classes. They experienced very little friction, and moderate levels of cohesiveness, competition and difficulty. A relatively wide distribution was found in the pupils' perceptions of classroom ethos. This suggests, as might be expected, that classroom ethos varies from one classroom to another. In addition, pupils within the same classroom may have different perceptions of classroom ethos. Overall, 5th graders were significantly more likely to perceive satisfaction, friction, and competitiveness in mathematics classes than 8th graders. 8th graders were more likely to perceive difficulties in mathematics classes than 5th graders. There was no significant difference in their perceptions of cohesiveness (see Figure 7.3.1 and Table 7.3.1).

Figure 7.3.1: Mean scores of pupils' perceptions of classroom ethos in mathematics classes

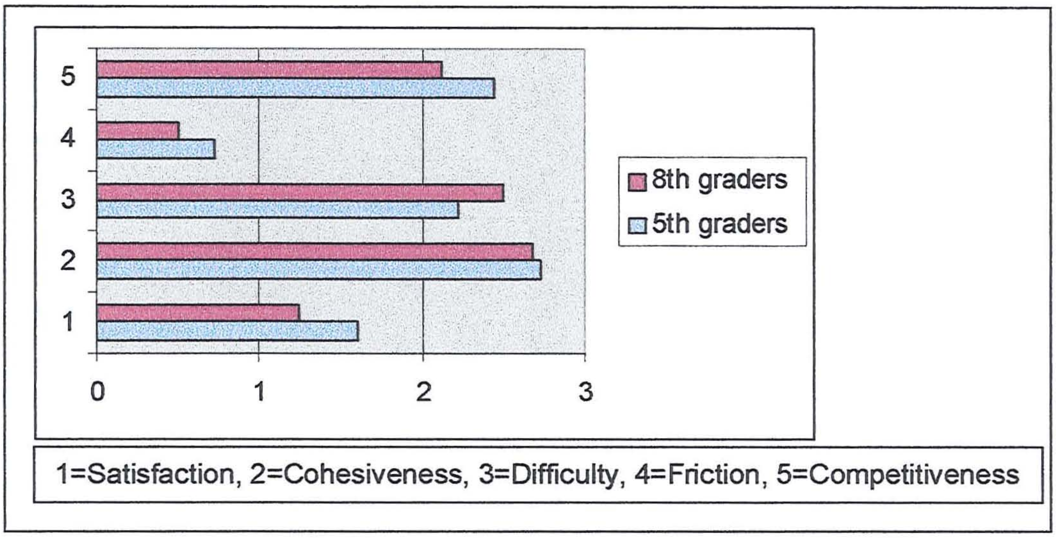


Table 7.3.1: Mean scores and standard deviation of pupils' perceptions of classroom ethos in mathematics classes

	5th graders			8th graders		
	N	M	SD	N	M	SD
Satisfaction t=7.211, df=2868.588, p<.01	1384	1.60	1.45	1981	1.24	1.37
Cohesiveness t=. 784, df=3336, p>.05	1377	2.73	1.70	1961	2.68	1.67
Difficulty t= 6.324, df=3140.930, p<.01	1396	2.22	1.24	1983	2.50	1.34
Friction t=6.629, df=2938.360, p<.01	1391	.72	.96	1985	.50	.93
Competitiveness t=5.984, df=2919.841, p<.01	1389	2.44	1.56	1978	2.12	1.51

Correlations were undertaken between the sub-scales for students of both age groups. A significant positive correlation existed between satisfaction and cohesiveness, among the responses of pupils of both age groups, although the correlations were relatively weak. There was also a weak but significant correlation between friction and competitiveness among the responses of 5th graders (Table 7.3.2).

Table 7.3.2: Correlation between five factors of classroom ethos, among the pupils' responses

	5^{th} graders	8^{th} graders
Satisfaction x Cohesiveness	r=.361, p=.000 (N=1353)	r=.308, p=.000 (N=1935)
Friction x Competitiveness	r=.357, p=.000 (N=1370)	

Pupils' perceptions of classroom ethos and their perceptions of teaching methods

This section examines the assumption that pupils' perceptions of classroom ethos affected their perceptions of the effects and deployment of different teaching methods. 5^{th} graders and 8^{th} graders were divided into two groups on the basis of their scores on the five factors of classroom ethos. Their perceptions of teaching methods were then compared, using Independent t-tests.

Satisfaction - Overall, most pupils experienced a low level of satisfaction. The mean satisfaction score of 5^{th} graders was 1.60 (SD=1.45, median=1.00). They were divided into those who scored above 2 (46.2%) and those who scored 0 or 1 (53.8%). 8^{th} graders reported less satisfaction than 5^{th} graders. The mean satisfaction score of 8^{th} graders was 1.24 (SD=1.37, median = 1.00). To obtain an equitable group size, 8^{th} graders were divided into those who scored above 1 (57.4%) and those who scored 0 (42.6%).

Cohesiveness - Overall, most pupils experienced a moderate level of cohesiveness in the mathematics classroom. The mean cohesiveness score of 5^{th} graders was 2.73 (SD=1.70, Median =3.00). 5^{th} graders were divided into those who scored at least 3 (53.2%) or below (46.8%). The mean cohesiveness scores of 8^{th} graders was 2.68 (SD=1.67, Median = 3.00). They were divided into those who scored at least 3 (50.5%) or below (49.5%).

Difficulty - Overall, pupils experienced moderate levels of difficulty. The percentage of pupils with higher difficulty scores was higher at 8^{th} grade than 5^{th} grade. The mean difficulty score of 5^{th} graders was 2.22 (SD=1.24, Median = 2.00). 5^{th} graders were divided into those who scored at least 3 (40.6%) or below 3 (59.4%). The mean difficulty score of 8^{th} graders was 2.50 (SD=1.34, Median = 2.00). 8^{th} graders were divided into those who scored at least 3 (50.0%) or below 3 (50.0%).

Friction - Overall, pupils experienced very low levels of friction in their mathematics classes, although the percentage of pupils perceiving friction in mathematics classes was higher at 5th grade than 8th grade. The mean friction score of 5th graders was .72 (SD=. 96, Median = .00). 5th graders were divided into those perceiving some friction (48.0%) and those perceiving none (52.0%). The mean friction of 8th graders was .50 (SD=. 93, Median =. 00). 8th graders were divided into those perceiving some friction (31.5%) and those perceiving none (68.5%).

Competitiveness - Overall, pupils experienced moderate level of competitiveness in mathematics classes, although the percentage of pupils with higher competitiveness scores was greater at 5th grade than 8th grade. The mean competition score of 5th graders was 2.44 (SD=1.56, median = 3.00). 5th graders were divided into those who scored at least 3 (52.1%) or below (47.9%). The mean competition scores of 8th graders was 2.12 (SD=1.51, median = 2.00). 8th graders were divided into those who scored at least 3 (45.3%) or below (54.7%).

Overall, pupils of both age groups with higher satisfaction and cohesiveness scores reported at least the same or more frequent deployment of all of the teaching methods. Their affective attitudes were reported as being promoted at least the same or more by all teaching methods except for *Using a computer*. Pupils of both age groups with lower satisfaction perceived that *Using a computer* could promote positive affective attitudes at least the same or more than pupils with higher satisfaction. 5th graders perceiving higher cohesiveness and 8th graders perceiving higher satisfaction perceived more frequent deployment of *Using a computer*.

5th graders' perceived frequency of deployment of *Reading a textbook* and *Individual help*, and 8th graders' perceived frequency of deployment of *Teacher explanation* and *Individual work* were not affected by their perceived satisfaction in mathematics classes. 8th graders' enjoyment and motivation promoted by *Practical work* were unlikely to be affected by their perceived satisfaction in mathematics classes. Pupils' affective attitudes promoted by individual learning methods and their perceptions of the frequency of these teaching methods were less likely to be affected by perceived cohesiveness in the classroom at both grades.

5th graders reporting higher difficulties perceived that positive affective attitudes were promoted by all the teaching methods except for *Using a computer* and *Individual help* less than those with fewer difficulties. They also perceived less frequent deployment of *Reading a textbook*, *Teacher explanation*, *Individual work* and *Whole-class discussion.* 8th graders with higher levels of difficulty perceived positive affective attitudes promoted by *Reading a textbook*, *Teacher explanation* and *Individual work* less and less frequent deployment of these teaching methods. This suggests that pupils experiencing more difficulties are less engaged in learning mathematics by any of the teaching methods used in their mathematics classes.

5th graders who perceived higher levels of friction perceived at least some aspects of positive affective attitudes were less promoted by *Reading a textbook*, *Teacher explanation*, *Whole-class discussion* and *Group discussion,* although they perceived a greater sense of progress promoted by *Using a computer.* 5th graders' perceptions of friction in mathematics classes did not seem to affect their perceptions of the frequency of deployment of teaching methods. 8th graders' experience of friction did not seem to affect their perceptions of the impact of different teaching methods on affective attitudes, but 8th graders with higher friction scores perceived less frequent deployment of *Teacher explanation.* This might be because pupils, especially 8th graders, overall perceived little friction in mathematics classes.

5th graders feeling higher competitiveness in mathematics classes perceived that at least some aspects of affective attitudes were promoted more by *Using a computer* and *Individual work.* Deployment of these teaching methods was perceived as greater than by those with lower competitiveness scores, while they perceived less frequent deployment of *Individual help.* 8th graders reporting higher competitiveness scores in mathematics classes perceived at least some aspects of positive affective attitudes were promoted more by *Reading a textbook*, *Teacher explanation*, *Individual work* and *Individual help,* while they perceived more frequent deployment of *Using a computer* and *Individual help* (see Table 7.3.3; Appendices 7.3.1-7.3.10).

Table 7.3.3: Pupils' perceptions of affective attitudes promoted by teaching methods according to higher and lower means of classroom ethos

			Enjoyment	Motivation	Sense of security	Sense of progress	Deployment
Satisfaction	5th	P<.01	**PW, UC, RT, TE, IW, IH, WD, GD**	**PW,RT,TE, IW, IH, WD, GD**	**PW, RT, TE, IW, IH, WD, GD**	**PW,RT,TE, IW, IH, WD, GD**	**PW,TE IW, WD, GD**
		Other		UC	UC	UC	UC, RT, IH
	8th	p<.01	**UC,RT,TE, IW, IH, WD**	**UC,RT,TE, IW, IH, WD,GD**	**PW, RT,TE, IW, IH, WD,GD**	**PW, UC,RT, TE,IW, IH, WD, GD**	**PW,UC,RT, IH, WD, GD**
		Other	PW,GD	PW	UC		TE,IW
Cohesiveness	5th	p<.01	**PW,RT,TE, WD, GD**	**PW,RT, TE, IH, WD, GD**	**PW,RT, TE, IW, IH, WD, GD**	**PW,RT,TE, IW, WD, GD**	**PW,UC,RT, TE, IH, WD, GD**
		Other	UC, IW, IH	UC,IW	UC	UC,IH	IW
	8th	p<.01	**PW, RT, TE,IH WD, GD**	**PW,RT, TE,IW, IH, WD, GD**	**PW,RT,TE, IW, IH, WD, GD**	**PW, RT,TE,IW, IH, WD, GD**	**PW, RT, TE, IH, WD, GD**
		Other	UC, IW	UC	UC	UC	UC, IW
Difficulty	5th	p<.01	**PW,RT,TE, IW,WD,GD**	**PW,RT,TE, IW,WD,GD**	**PW,RT,TE, IW,WD,GD**	**PW,RT,TE, IW,IH,WD, GD**	**RT,TE,IW,WD**
		Other	UC,IH	UC,IH	UC,IH	UC	PW,UC,IH, GD
	8th	p<.01	**RT,TE,IW**	**RT,TE,IW**	**RT, TE,IW**	**RT, TE, IW**	**RT, TE, IW**
		Other	PW,UC, IH,WD, GD	PW,UC, IH,WD, GD	PW,UC, IH,WD, GD	PW,UC, IH,WD, GD	PW,UC, IH,WD, GD
Friction	5th	p<.01	**RT,TE,WD,GD**	**TE,WD,GD**	**WD, GD**	**UC, RT,TE, WD,GD**	
		Other	PW,UC, IW,IH	PW,UC,RT, IW,IH	PW, UC,RT,TE, IW,IH	PW,IW,IH	PW,UC,RT,TE, IW, IH, WD, GD
	8th	p<.01					**TE**
		Other	PW,UC,RT,TE, IW, IH, WD, GD	PW,UC,RT,TE, IW, IH, WD, GD	PW,UC,RT,TE, IW, IH, WD, GD	PW,UC,RT,TE, IW, IH, WD, GD	PW,UC,RT, IW, IH, WD, GD
Competitiveness	5th	p<.01	**UC**	**UC,**	**UC, IW,**	**UC, IW**	**UC, IW,IH**
		Other	PW,RT,TE, IW, IH, WD, GD	PW,RT,TE, IW, IH, WD, GD	PW,RT,TE, IH, WD, GD	PW,RT,TE, IH, WD, GD	PW,RT,TE, WD, GD
	8th	p<.01		**TE, IW, IH**	**RT,TE,IW, IH**	**RT, TE, IH**	**UC,IH**
		Other	PW,UC,RT,TE, IW, IH, WD, GD	PW,UC,RT, WD, GD	PW,UC,WD,GD	PW,UC, IW,WD,GD	PW,RT,TE, IW,WD,GD

NB. Teaching methods in bold are those where there were significant differences between the groups. The teaching methods in red are those where students with lower scores of factors perceive more frequent deployment and more positive affective attitudes. Full details see Appendices 7.3.1-7.3.10.

Teachers' perceptions

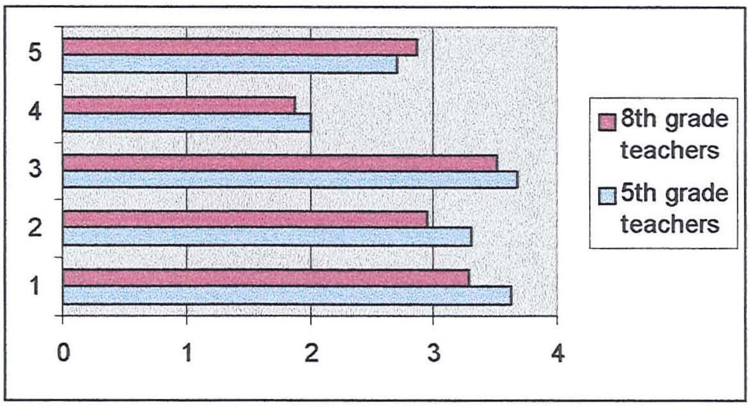
Teachers were asked about their attempts to improve ethos in mathematics classes, using five-point rating scales, 5 for always and 1 for never:

- to what extent they attempted to improve their pupils' satisfaction;
- to what extent they attempted to improve their pupils' cohesiveness;
- to what extent they attempted to reduce pupils' difficulty.
- how often they noticed friction between pupils,

- to what extent they agreed that competition between pupils could be used for improving pupils' motivation to learn mathematics.

Teachers of both age groups reported 'sometimes' attempting to improve satisfaction and cohesiveness and reduce difficulties in mathematics classes. Teachers of both age groups hardly ever noted friction in mathematics classes and tended to slightly disagree that competition could be used for the promotion of pupils' motivation to learn mathematics. No statistically significant differences were found in the teachers' attempts to improve classroom ethos between teachers from the different age groups (Figure 7.3.2 and Table 7.3.4).

Figure 7.3.2: Mean scores of teachers' perceptions of classroom ethos and their attempts to improve classroom ethos (age group comparison)



1=Improving satisfaction, 2=Improving cohesiveness, 3=Reducing difficulty
4=Notion of friction, 5=Using competition for promotion of motivation

Table 7.3.4: Mean scores and Standard Deviation of teachers' perceptions of classroom ethos and their attempts to improve classroom ethos

	5th grade teachers			8th grade teachers		
	N	M	SD	N	M	SD
Improving satisfaction: t=1.807, df=81, p>.05	43	3.63	.85	40	3.28	.93
Improving cohesiveness: t=1.855, df=86, p>.05	47	3.30	.88	41	2.95	.86
Reducing difficulty: t=. 933, df=87, p>.05	47	3.68	.78	42	3.52	.80
Notion of friction: t=. 776, df=86, p>.05	46	2.00	.73	42	1.88	.71
Using competition for promoting motivation t= .730, df=87, p>.05	47	2.70	1.06	42	2.86	.93

The extent to which teachers' reported attempts to improve their pupils' satisfaction was positively correlated with the extent of their reported attempts to reduce their pupils' difficulties at both grades, although the correlation was stronger at 8th grade. The degree of teachers' reported attempts to improve pupils' cohesiveness was positively correlated with the degree of their reported attempts to improve their pupils' satisfaction and their reported attempts to reduce their pupils' difficulties at 5th grade. These correlations were not found at 8th grade which suggests that 8th grade teachers do not tend to believe that cohesiveness in mathematics classes is linked to pupils' satisfaction or reduction of difficulties (see Table 7.3.5).

Table 7.3.5: Correlation between five factors of classroom ethos, among the teachers' responses

	5th grade teachers	8th grade teachers
Improvement of Cohesiveness x Improvement of Satisfaction	N=43, r=.504, p=.001	
Improvement of Satisfaction x Reduction of Difficulties	N=43, r=.463, p=.002	N=40, r=.580, p=.000
Improvement of Cohesiveness x Reduction of Difficulties	N=47, r=.392, p=.006	

Teachers' perceptions of classroom ethos and their perceptions of teaching methods

Teachers were divided into two groups in terms of their perceptions of classroom ethos. Their perceptions of the effects and deployment of particular teaching methods were compared between groups, using an Independent t-test. Firstly, the way that teacher participants were divided into two groups is explained.

Satisfaction - Most teachers expressed high to moderate levels of attempting to improve pupils' satisfaction in mathematics classes, although the percentage of teachers who scored higher marks was greater at 5th than 8th grade. The mean scores for improving pupils' satisfaction at 5th grade was 3.63 (SD=. 85, median = 4.00). 5th grade teachers were divided into those who scored at least 4 (58.1%) or below 4 (41.9%). The mean scores for improving satisfaction of 8th grade teachers was 3.28 (SD=. 93, median = 3.00). 8th grade teachers were divided into those who scored at least 4 (40.0%) or below 4 (60%).

Cohesiveness - Most teachers expressed moderate levels of attempting to improve cohesiveness in the classroom, although the percentage of teachers scoring high marks was higher at 5th than 8th grade. The mean score of improving pupils' cohesiveness for 5th grade teachers was 3.30 (SD=. 88, median = 3.0). 5th grade teachers were divided into those who scored at least 4 (40.4%) or below 4 (59.6%). The mean score of improving pupils' cohesiveness for 8th grade teachers was 2.95 (SD=. 86, median = 3.0). However, 41.5% of 8th grade teachers scored 3. Therefore, it was difficult to divide them into equivalent sized groups. 65.9% of 8th graders scored at least 3 and 34.1 % scored below. These groups were used for the analysis.

Difficulty - Most teachers indicated moderate to high attempts to reduce pupils' difficulties, although the percentage was higher at 5th grade than 8th grade. The mean score for reducing pupils' difficulty for 5th grade teachers was 3.68 (SD=. 78, median = 4.00). 5th grade teachers were divided into those who scored at least 4 (61.7%) or below 4 (38.3%). The mean score for reducing pupils' difficulty of 8th grade teachers was 3.52 (SD= .80, median = 3.00). 8th grade teachers were divided into those who scored at least 4 (42.9%) or below 4 (57.1%).

Friction - Overall, teachers perceived little friction in their mathematics classes. The mean score of 5th grade teachers' perceptions of friction in mathematics classes was 2.00 (SD=. 73, median = 2.00), and 8th graders 1.88 (SD=. 71, median = 2.00). Teachers of both age groups were divided into two groups, those who perceived friction at least sometimes (21.7% of 5th grade teachers and 19.0% of 8th grade teachers) and those who perceived friction never or hardly ever (78.3% of 5th grade teachers and 81.0% of 8th grade teachers).

Competitiveness - The mean scores of 5th grade teachers' responses to using competition for promoting pupils' motivation was 2.70 (SD= 1.06, median = 3.00). This indicates moderate agreement. The mean scores of 8th grade teachers was 2.86 (SD=. 93, median = 3.00). 50 % of 8th grade teachers responded that they were neutral about using competition for promoting pupils' motivation. Teachers were divided into two groups; those expressing at least neutral feelings (59.6% of 5th grade teachers and 71.4% of 8th grade teachers) and those expressing disagreement or absolute disagreement (40.4% of 5th grade teachers and 28.6% of 8th grade teachers).

5^{th} grade teachers seemed to see relationships between improvement of satisfaction and enjoyment promoted by *Practical work*, improvement of cohesiveness and sense of progress promoted by *Group discussion*, and reduction of difficulties and motivation promoted by *Individual work*. 5^{th} grade teachers attempting to improve class cohesiveness and reduce pupils' difficulties reported more frequent deployment of *Group discussion.*

8^{th} grade teachers seemed to see relationships between improvement of satisfaction and motivation promoted by *Individual help*, and improvement of cohesiveness and sense of security promoted by *Whole-class discussion.* 8^{th} grade teachers who believed that competition could be used for improving pupils' motivation perceived that *Individual work* could promote enjoyment. 8^{th} grade teachers attempting to improve pupils' satisfaction reported more frequent deployment of *Individual help* than other teachers. There were no other differences in teachers' reported frequency of deployment of teaching methods according to their perceptions of classroom ethos. The findings suggest that 5^{th} grade teachers view improvement of classroom ethos in relation to *Group discussion* and *Practical work*, while 8^{th} grade teachers think of it in relation to individualised teaching methods (see Table 7.3.6).

Table 7.3.6: Teachers' perceptions of affective attitudes promoted by teaching methods according to higher and lower means of their classroom ethos

					Low scores			High scores		
					N	M	SD	N	M	SD
5^{th}	Satisfaction	Enjoyment	Practical work	$t=2.807$, $df=41$, $p<.01$	18	4.28	.57	25	4.72	.46
8^{th}	Satisfaction	Motivation	Individual help	$t=2.777$, $df=38$, $p<.01$	24	3.83	.70	16	4.44	.63
8^{th}	Satisfaction	Deployment	Individual help	$t=3.052$, $df=38$, $p<.01$	24	3.67	.82	16	4.44	.73
5^{th}	Cohesiveness	Progress	Group discussion	$t=3.029$, $df=45$, $p<.01$	28	3.43	.63	19	4.11	.81
5^{th}	Cohesiveness	Deployment	Group discussion	$t=4.342$, $df=29.166$, $p<.01$	28	2.04	.64	19	3.11	.94
8^{th}	Cohesiveness	Security	Whole-class discussion	$t=3.366$, $df=32.587$, $p<.01$	13	2.92	.49	26	3.58	.70
5^{th}	Difficulty	Motivation	Individual work	$t=3.709$, $df=45$, $p<.01$	18	3.22	.81	29	3.97	.57
5^{th}	Difficulty	Deployment	Group discussion	$t=2.802$, $df=44.916$, $p<.01$	18	2.06	.64	29	2.72	1.00
8^{th}	Competition	Enjoyment	Individual work	$t=2.805$, $df=37.210$, $p<.01$	12	3.17	.39	30	3.67	.76

Summary of 7.3

Pupils of both age groups, overall, experienced relatively low satisfaction and moderate levels of difficulty in mathematics classes, although no significant correlations between these factors were found at either grade. Teachers of both age groups, especially 8th grade teachers, acknowledged a relationship between improvement of pupils' satisfaction and reduction of pupils' difficulties. They reported that they attempted to improve satisfaction and reduce difficulties in mathematics classes sometimes.

Pupils reported moderate levels of cohesiveness. Perceived cohesiveness was correlated with satisfaction at both levels. Relationships between the extent of attempts to improve cohesiveness and satisfaction, and cohesiveness and reducing difficulties were found among the perceptions of 5th grade teachers, but not 8th grade teachers. Pupils of both age groups, overall, felt moderate levels of competitiveness in mathematics classes, while teachers expressed neutral feelings about using competition for promoting pupils' motivation. Both pupils and teachers reported very little friction in mathematics classes. 5th graders experienced more friction and competitiveness than 8th graders. These elements were positively correlated at 5th grade.

Perceived satisfaction and cohesiveness in class were positively correlated with the perceived frequency of deployment of all teaching methods and positive affective attitudes promoted by different teaching methods at both grades. *Using a computer* was the teaching method, which was least likely to be affected by perceptions of satisfaction and cohesiveness. Individual teaching methods, especially doing individual work, was also less affected by pupils' perceptions of class cohesiveness. For 8th graders, enjoyment and motivation promoted by *Practical work* were less affected by their perceived satisfaction in doing mathematics.

5th graders' perceived difficulty was negatively correlated with perceived affective attitudes promoted by all teaching methods except for *Using a computer* and *Individual help*. Friction was negatively correlated with positive affective attitudes promoted by *Reading a textbook*, *Teacher explanation*, *Whole-class discussion* and *Group discussion,* but levels of friction did not affect perceived frequency of deployment of any teaching methods. 5th graders' reported competitiveness in class, overall, did not affect their perceptions of teaching methods, except for *Using a computer* and doing *Individual work.* However, 5th graders perceiving higher competitiveness reported less *Individual help.*

For 8th graders, lower difficulty and higher competitiveness had positive effects on perceived affective attitudes as promoted by *Reading a textbook*, *Teacher explanation* and individualised methods. Perceived lower levels of difficulty also affected the perceived frequency of deployment of these teaching methods positively. 8th graders' perceptions of the level of friction, overall, did not affect their affective attitudes promoted by different teaching methods. However, 8th graders reporting lower friction perceived a higher frequency of deployment of *Teacher explanation.*

5th grade teachers who had a high concern for classroom ethos in mathematics classes were likely to take a greater interest in *Practical work* and *Group discussion*, although those attempting to reduce pupils' difficulty in mathematics learning believed more that individual work promoted pupils' motivation. 8th grade teachers who had a higher level of concern for classroom ethos in mathematics classes were likely to emphasise individual work and help, although those attempting to improve cohesiveness in mathematics classes perceived that *Whole-class discussion* could promote pupils' sense of security more than their colleagues.

7.4: Goal setting reflected in teachers' praise

Pupils' perceptions

In the questionnaire survey, pupils were asked to what extent they perceived that their mathematics teachers praised them according to the following four criteria:

- when pupils get good results in Maths tests, compared to other pupils;
- when pupils have improved the results of Maths tests over their previous results;
- when pupils make more effort in Maths, compared to other pupils;
- when pupils make more effort in Maths than before.

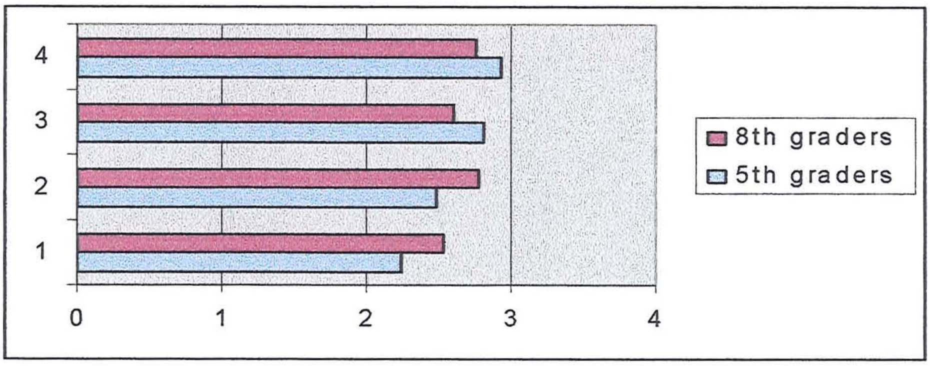
Pupils' perceptions of teachers' praise were measured with five-point rating scales. They were also asked to what extent they were happy to receive praise from their teacher.

Overall, pupils of both age groups perceived that their teachers hardly ever praised them, although there was a relatively wide distribution of responses. Pupils of both age groups perceived differences in the extent to which they were praised for different reasons. 5th graders perceived that their teachers gave praise for effort more than results, while 8th graders perceived that their teachers praised them based on absolute comparisons, such as improvement in results or more effort than before, more than for relative comparisons with other pupils (see Figure 7.4.1). 5th graders were more likely to perceive that their teachers praised them based on effort than 8th graders, while 8th graders were more likely to perceive that their teachers praised them based on results than 5th graders. This difference was statistically significant (see Table 7.4.1 and Figure 7.4.1).

Table 7.4.1: Mean scores and Standard Deviation of pupils' perceptions of the extent to which mathematics teachers praised them

	5th graders			8th graders		
	N	M	SD	N	M	SD
Better results than others t=6.878, df=3277.287, p<.01	1465	2.24	1.19	2087	2.53	1.28
Improvement of results than before t=6.281, df=3558, p<.01	1467	2.49	1.29	2093	2.78	1.33
More effort than others t=4.476, df=3024.296, p<.01	1469	2.81	1.36	2092	2.61	1.27
More effort than before t=3.858, df=3033.615, p<.01	1467	2.93	1.40	2093	2.75	1.32
Repeated measure ANOVA	F (2.649, 3873.533) =227.514, p<. 01			F(2.649,5514.807) =67.364, p<. 01		

Figure 7.4.1: Mean scores of pupils' perceptions of the extent to which mathematics teachers praised pupils (age group comparison)



1=Better results than others, 2=Improvement results than before, 3=More effort than others, 4=More effort than before

There were relatively high correlations between pupils perceptions of praise given for different reasons (Table 7.4.2).

Table 7.4.2: Correlation between pupils' perceptions of their teachers' praise

	5th graders			8th graders		
	N	r	p	N	r	p
Results others x Results before	1465	.712	.000	2086	.729	.000
Results others x Effort others	1465	.535	.000	2085	.687	.000
Results others x Effort before	1463	.543	.000	2084	.661	.000
Results before x Effort others	1467	.634	.000	2091	.737	.000
Results before x Effort before	1465	.653	.000	2090	.824	.000
Effort others x Effort before	1466	.729	.000	2091	.818	.000

Pupils of both age groups on average acknowledged being neutral to happy when praised by teachers. Pupils of both age groups felt happier with praise when it was given for self improvement rather than comparison with others. 41.7% of 8th graders expressed that they were "very happy" with praise for improvement of results, while 41.2% of 5th graders expressed being "very happy" with praise for more effort than before. 8th graders were more likely than 5th graders to feel happy when their mathematics teachers praised them based on their results, e.g. getting higher marks than others or improving marks than 5th graders. No statistically significant difference was found in 5th and 8th grade pupils' feeling of happiness after being praised for effort. There was a relatively wide distribution of responses to pupils' feeling happy with their mathematics teachers praising them, irrespective of the reasons for the teachers' praise (see Table 7.4.3 and Figure 7.4.2).

Table 7.4.3: Mean scores and Standard Deviation of the extent to which pupils feel happy with teachers' praise on them in mathematics classes

	5th graders			8th graders		
	N	M	SD	N	M	SD
Better results than others t=5.716, df=3069.042, p<.01	1461	3.39	1.34	2106	3.64	1.29
Improvement results than before t=5.858, df=3024.762, p<.01	1460	3.71	1.26	2106	3.96	1.19
More effort than others t=.292, df=3048.157, p>.05	1459	3.51	1.30	2106	3.49	1.24
More effort than before t=.497, df=3045.469, p>.05	1461	3.82	1.29	2105	3.80	1.23
Repeated measure ANOVA	F(2.804,4085.793) =84.935, p<. 01			F(2.588,5442.450) =173.038, p<. 01		

Figure 7.4.2: Mean scores of the extent to which pupils feel happy with teachers' praise of them in mathematics classes (age group comparison)

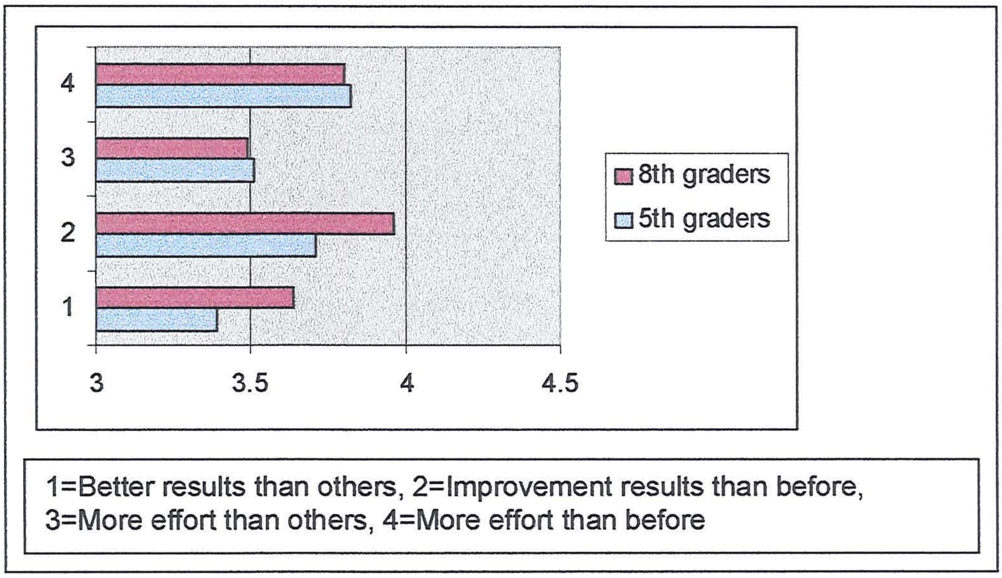


Table 7.4.4: Correlation between pupils' feeling happy with teachers' praise

	5th graders			8th graders		
	N	r	p	N	R	p
Results others x Results before	1460	.655	.000	2106	.696	.000
Results others x Effort others	1458	.567	.000	2106	.686	.000
Results others x Effort before	1458	.495	.000	2104	.553	.000
Results before x Effort others	1458	.601	.000	2016	.664	.000
Results before x Effort before	1458	.635	.000	2104	.740	.000
Effort others x Effort before	1459	.644	.000	2104	.756	.000

Overall, pupils, who felt happy with teachers' praise in mathematics classes, felt so, irrespective of the reasons for the praise (see Table 7.4.4).

There may be a relationship between pupils reporting feeling happy with their teachers' results-based praise and their teachers actually adopting results-based praise in mathematics classes. For instance, 5th graders, who felt happy with teacher's praise based on better results than others, were likely to perceive that their teachers gave this kind of praise (N=1453, r=. 323, p=. 000). 5th graders, who felt happy with the teacher's praise based on better results than before, were likely to perceive that their teachers gave this kind of praise (N=1455, r=. 384, p=. 000). Young pupils may appreciate being praised based on their results when the praise relates to what they perceive to be the teacher's values. 8th graders were happy with receiving teachers' praise irrespective of the reasons for it or their perceptions of the teachers' values.

Pupils' perceptions of teachers' praise and their perceptions of teaching methods

Table 7.4.5: Division of pupils perceiving their teachers using particular teaching methods with higher frequency and pupils perceiving their teachers using the kind of praise with lower frequency

	5th graders		8th graders	
	Lower Frequency	Higher Frequency	Lower Frequency	Higher Frequency
Better results than others	M=2.24, SD=1.19, Median=2.00		M=2.53,SD=1.28,Median=3.00	
	59%	41%	48.3%	51.7%
Improvement results than before	M=2.49,SD=1.29, Median=2.00		M=2.78, SD=1.33,Median=3.00	
	50.4%	49.6%	40.4%	59.6%
More effort than others	M=2.81,SD=1.36,Median=3.00		M=2.61,SD=1.27,Median=3.00	
	40.3%	59.7%	46.3%	53.7%
More effort than before	M=2.93,SD=1.40,Median=3.00		M=2.75,SD=1.32,Median=3.00	
	38.2%	61.8%	41.5%	58.5%

59% of 5th graders and 48.3% of 8th graders perceived that their teachers never or hardly ever praised them because they achieved better results than others. 50.4% of 5th graders and 40.4% of 8th graders perceived that their teachers never or hardly ever praised them because they had improved their results from before. 40.3% of 5th graders and 46.3% of 8th graders perceived that their teachers never or hardly ever praised them because they made more effort than others. 38.2% of 5th graders and 41.5% of 8th graders perceived that their teachers never or hardly ever praised them because they made more effort than before (see Table 7.4.5).

Overall, 5th graders receiving more frequent praise in mathematics classes perceived more frequent deployment of *Practical work, Individual help*, and *Group discussion.* They also perceived more frequent deployment of *Whole-class discussion* except when praise was for better results than others. They also perceived more frequent deployment of *Using a computer* when praise was for better results than others and enhancement of effort.

Overall, 8th graders receiving frequent praise perceived more frequent deployment of all of the teaching methods except for *Reading a textbook* and *Individual work.* No significant difference was found in 8th graders' perceptions of the frequency of deployment of *Using a computer* according to their perceptions of the extent to which their teacher praised them based on improvement in results.

Pupils of both grades receiving more frequent praise perceived that positive affective attitudes were promoted by all teaching methods, although there were some exceptions. Of these, *Using a computer, individual work* and *Individual help* were the teaching methods least affected by pupils' perceived frequency of teacher praise. However, 5th graders perceiving a higher frequency of adoption of teacher praise perceived more that receiving individual help could promote pupils' positive affective attitudes towards mathematics learning. No significant difference was found in 5th graders' sense of progress promoted by *Whole-class discussion* according to the perceived frequency of the teacher's praise for better results than others.

Pupils' perceived frequency of teacher praise seemed to affect pupils' perceptions of the effects of teaching methods on attitudes more at 8th grade than 5th grade. 8th graders' enjoyment promoted by *Practical work* and *Using a computer* was not statistically significantly different according to their perceived frequency of teacher's praise, irrespective of its kind. No significant difference was found in 8th graders' enjoyment promoted by *Reading a textbook* when the teacher's praise was directed to improvement of results. 8th graders did perceive more positive affective attitudes promoted by

Individual work when they felt more frequent teacher's praise for better results than others, but for no other reasons (see Table 7.4.6, See details Appendices 7.4.1-7.4.8).

Table 7.4.6: Pupils' perceptions of the frequency of deployment of teaching methods and affective attitudes promoted by these teaching methods according to their perceived frequency of teacher's praise

			Enjoyment	Motivation	Sense of security	Sense of progress	Deployment
Better results than others	**5th**	**p<.01**	**PW, RT, TE, IW, IH, WD, GD**	**PW, RT, TE, IW, IH, WD, GD**	**PW, RT,TE, IH, WD, GD**	**PW, RT, TE, GD**	**PW,UC, IH, GD**
		Other	UC	UC	UC,IW	UC,IW,IH,WD	RT,TE,IW,WD
	8th	p<.01	**RT, TE, IW, IH, WD, GD**	**PW,UC,RT,TE, IW, IH, WD, GD**	**PW,UC,RT,TE IW, IH, WD, GD**	**PW,UC,RT, TE, IW, IH, WD, GD**	**PW,UC, TE, IH, WD, GD**
		Other	PW,UC				RT,IW
Improvement of results	**5th**	**p<.01**	**PW, RT,TE, IH, WD, GD**	**PW, RT,TE, IH, WD, GD**	**PW, RT,TE, IH, WD, GD**	**PW, RT, TE, WD, GD**	**PW, IH, WD, GD**
		Other	UC,IW	UC,IW	UC,IW	UC,IW,IH	UC,RT,TE,IW
	8th	p<.01	**TE, IW, IH, WD, GD**	**PW,UC,RT,TE, IW, IH, WD, GD**	**PW,UC,RT,TE, IH, WD,GD**	**PW,UC,RT,TE, IW,IH,WD,GD**	**PW,TE, IH,WD,GD**
		Other	PW,UC,RT		IW		UC,RT,IW
More effort than others	**5th**	**p<.01**	**PW,RT,TE, WD, GD**	**PW,RT, TE, IW, IH, WD, GD**	**PW,RT,TE, IH, WD, GD**	**PW,RT,TE, WD, GD**	**PW, IH, WD, GD**
		Other	UC,IW,IH	UC	UC,IW,	UC,IW,IH	UC,RT,TE,IW
	8th	p<.01	**RT,TE, IW,IH, WD,GD**	**PW,UC,RT,TE, IW,IH, WD,GD**	**PW,UC,RT,TE, IH,WD,GD**	**PW,UC,RT,TE, IW,IH, WD,GD**	**PW,UC,TE, IH, WD,GD**
		Other	PW,UC		IW		RT,IW
More effort than before	**5th**	**p<.01**	**PW,RT,TE, IH, WD,GD**	**PW,RT,TE, IW, IH,WD,GD**	**PW,RT,TE, IH,WD, GD**	**PW,RT,TE, IW, IH,WD,GD**	**PW,UC, IH,WD, GD**
		Other	UC,IW	UC	UC,IW	UC	RT,TE,IW
	8th	p<.01	**RT,TE, IW, IH, WD,GD**	**PW,UC,RT,TE, IW, IH, WD,GD**	**PW,UC,RT,TE, IH,WD,GD**	**PW,UC,RT, TE, IW, IH, WD, GD**	**PW,UC,TE, IH, WD,GD**
		Other	PW,UC		IW		RT,IW

NB. Teaching methods in bold are those where there were significant differences between the groups. Full details see Appendices 7.4.1-7.4.8.

Pupils were asked to what extent they felt happy with receiving each type of praise. Pupils of both age groups felt happy with praise given for improvement of results or increased effort. Most 8th graders felt happy when praise was given for improvement of results. 50.7% of 5th graders and 59.6% of 8th graders expressed absolute agreement or agreement about feeling happy when given praise for being better than others. 62.7% of 5th graders and 73.9% of 8th graders expressed absolute agreement or agreement about feeling happy when given praise for improvement of results. 54.9% of 5th graders and 52.5% of 8th graders expressed absolute agreement or agreement about feeling happy when given praise for making more effort than others. 66.4% of 5th graders and 66.6% of 8th graders expressed absolute agreement or agreement about feeling happy when given praise for increased effort (see Table 7.4.7).

Table 7.4.7: Division of pupils feeling happy with teachers' praise with higher agreement and lower agreement

	5th graders		8th graders	
	Lower happiness	Higher happiness	Lower happiness	Higher happiness
Better results than others	M=3.39,SD=1.34,Median=4.00		M=3.64,SD=1.29,Median=4.00	
	49.3%	50.7%	40.4%	59.6%
Improvement results than before	M=3.71,SD=1.26,Median=4.00		M=3.96,SD=1.19,Median=4.00	
	37.3%	62.7%	26.1%	73.9%
More effort than others	M=3.51,SD=1.30,Median=4.00		M=3.49,SD=1.24,Median=4.00	
	45.1%	54.9%	47.5%	52.5%
More effort than before	M=3.82,SD=1.29,Median=4.00		M=3.80,SD=1.23,Median=4.00	
	33.6%	66.4%	33.4%	66.6%

Table 7.4.8: Pupils' perceptions of the frequency of deployment of teaching methods and affective attitudes promoted by these teaching methods according to their feeling happy with the teacher's praise

			Enjoyment	Motivation	Sense of security	Sense of progress	Deployment
Happy Better results than others	**5th**	**p<.01**	**PW,RT,TE, IW,IH,GD**	**PW,UC,RT,TE, IW, IH,WD,GD**	**PW,UC,RT,TE, IW, IH, WD,GD**	**PW,UC,RT,TE, IH,WD,GD**	**RT,TE,IW,IH**
		Other	UC,WD			IW	PW,UC,WD,GD
	8th	p<.01	**UC,RT,TE, IW,IH,WD,GD**	**PW,UC,RT,TE, IW, IH, WD, GD**	**PW,UC,RT,TE, IW, IH, WD, GD**	**PW,UC,RT,TE, IW, IH, WD,GD**	**RT,TE, IW,IH,WD**
		Other	PW				PW,UC,GD
Happy Improvement of results	**5th**	**p<.01**	**PW,RT,TE, IW,IH,WD,GD**	**PW,RT,TE, IW,IH,WD,GD**	**PW,RT,TE, IW,IH,WD,GD**	**PW,RT,TE, IW,IH,WD,GD**	**PW,RT,TE, IW,IH,WD,GD**
		Other	UC	UC	UC	UC	UC
	8th	p<.01	**PW,UC,RT, TE, IW, IH, WD, GD**	**PW,UC,RT,TE, IW, IH, WD, GD**	**PW,UC,RT, TE, IW, IH, WD, GD**	**PW,UC,RT, TE, IW, IH, WD, GD**	**PW,RT, TE, IW, IH, WD, GD**
		Other					UC
Happy More effort than others	**5th**	**p<.01**	**PW,RT,TE, IW,IH,WD,GD**	**PW,RT,TE, IW,IH,WD,GD**	**PW,RT,TE, IW,IH,WD,GD**	**PW,RT,TE, IW,IH,WD,GD**	**TE, IW,IH,WD**
		Other	UC	UC	UC	UC	PW,UC,RT,GD
	8th	p<.01	**PW,UC,TE, IW,IH,WD,GD**	**PW,UC,RT,TE, IW, IH, WD, GD**	**PW,UC,RT,TE, IW, IH, WD, GD**	**PW,UC,RT,TE, IW, IH, WD, GD**	**PW,RT,TE, IH,WD, GD**
		Other	RT				UC,IW
Happy More effort than before	**5th**	**p<.01**	**PW,RT,TE, IW,IH,WD,GD**	**PW,RT,TE, IW,IH,WD,GD**	**PW,RT,TE, IW,IH,WD,GD**	**PW,UC,RT,TE, IW, IH, WD, GD**	**PW,RT,TE, IW,IH,WD,GD**
		Other	UC	UC	UC		UC
	8th	p<.01	**PW,UC,RT,TE, IH,WD, GD**	**PW,UC,RT,TE, IW, IH, WD, GD**	**PW,UC,RT,TE, IW, IH, WD, GD**	**PW,UC,RT,TE, IW, IH, WD, GD**	**PW,UC,RT,TE, IW, IH, WD, GD**
		Other	IW				

NB. Teaching methods in bold are those where there were significant differences between the groups. Full details see Appendices 7.4.9-7.4.16.

Table 7.4.8 indicates that there were significant differences in relation to the deployment and perceived effects on attitudes in relation to almost every teaching method between pupils who were happy to receive praise.

5^{th} graders who felt happy with teacher praise based on individual improvement perceived a greater frequency of deployment of all teaching methods except for *Using a computer.* 5^{th} graders who felt happy with teacher praise for being better than others perceived more frequent deployment of teacher explanation and individualised teaching methods. 8^{th} graders' appreciation of teacher praise affected the perceived frequency of deployment of different teaching methods except for *Using a computer.* No significant difference was found in the perceived frequency of *Practical work* and *Group discussion* between 8^{th} graders who felt happy with teacher praise based on better results than others and those who did not.

Those who felt happy with teacher praise perceived to a great extent that their affective attitudes towards mathematics learning were promoted by all teaching methods at both grades. Of these, *Using a computer* was the teaching method, least affected by appreciation of teacher praise at 5^{th} grade. No significant difference was found between enjoyment promoted by *Whole-class discussion* and sense of progress promoted by *Individual work* between 5^{th} graders who appreciated teacher praise based on better results than others and those who did not.

8^{th} graders' enjoyment promoted by some teaching methods was less affected by their appreciation of teacher praise than other aspects of affective attitudes. 8^{th} graders' appreciation of teacher praise based on better results than others did not affect their enjoyment promoted by *Practical work.* Their appreciation of teacher praise based on more effort than others did not affect their enjoyment promoted by *Reading a textbook.* Their appreciation of teacher praise based on more effort than before did not affect their enjoyment promoted by *Individual work* (see Table 7.4.8).

Teachers' perceptions

In the questionnaire survey, teachers were asked to indicate the extent to which they praised their pupils in mathematics classes according to each of four criteria of teachers' praise:

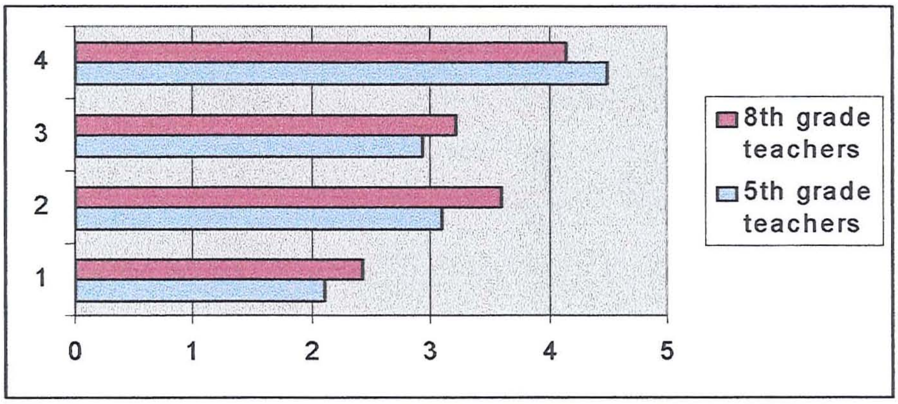
- when pupils get good results in Maths tests, compared to other pupils;
- when pupils have improved results in Maths tests over previous results;
- when pupils make more effort in Maths, compared to other pupils;
- when pupils make more effort in Maths than before.

Teachers' perceptions of the extent to which they praised their pupils in mathematics classes were measured with five-point rating scales; 5 for always and 1 for never. The extent to which teachers reported praising their pupils differed according to the reason for praise. These differences were statistically significant. Teachers of both age groups were most likely to praise their pupils when they made more effort than before. 93.6% of 5^{th} grade teachers and 81.0% of 8^{th} grade teachers reported that they always or nearly always praised pupils for this reason. On average, they reported that they praised their pupils for this reason nearly always. A relatively small distribution of scores was found, in teachers' praising their pupils for this reason, especially among the responses of 5^{th} grade teachers. Teachers of both age groups reported praising their pupils sometimes based on pupils' improvement of results, and sometimes based on their pupils' making more effort than others. Teachers of both age groups were least likely to praise their pupils for better results than others. They reported that they hardly ever praised their pupils for this. 5^{th} grade teachers adopted praise based on more effort than before more specifically than other kinds of praise, while 8^{th} grade teachers tended to adopt praise based on absolute comparison rather than praise based on relative comparison. No significant difference ($p<.01$) was found in the teachers' reported praise of their pupils, irrespective of the reasons for the praise, between the responses of teachers of the different age groups (see Table 7.4.9 and Figure 7.4.6).

Table 7.4.9: Mean scores and Standard Deviation of teachers' perceptions of the extent to which they praise their pupils in mathematics classes

	5th grade teachers			8th grade teachers		
	N	M	SD	N	M	SD
Better results than others t=1.370, df=87, p>.05	47	2.11	1.03	42	2.43	1.19
Improvement results than before t=2.031, df=87, p>.01	47	3.09	1.21	42	3.60	1.15
More effort than others t=.926, df=87, p>.05	47	2.94	1.42	42	3.21	1.41
More effort than before t=2.093, df=87, p>.01	47	4.49	.62	42	4.14	.93
Repeated measure ANOVA	F(2.193, 100.863) =43.911, p<. 01			F(3,123) =30.750, p<. 01		

Figure 7.4.3: Mean scores of pupils' perceptions of the extent to which mathematics teachers praise pupils (age group comparison)



1=Better results than others, 2=Improvement results than before, 3=More effort than others, 4=More effort than before

5th grade teachers, overall, who gave result-based praise were likely to do so based on both relative comparisons and absolute comparisons (r=. 464, p=. 001). 8th grade teachers seemed to praise their pupils in an integrated way. There were positive correlations ranging from r=. 423 to r=. 671, between the various types of praise used.

The relationships between teachers' reported frequency of adoption of praise and their perceptions of the effects and deployment of different teaching methods were not examined, due to the skewed distribution of responses. 10.6% of 5th grade teachers and 19.0% of 8th grade teachers replied that they always or nearly always praised pupils for better results than others, while 93.6% of 5^{th} grade teachers and 81.0% of 8^{th} grade teachers replied that they always or nearly always praised pupils for increased effort.

Summary of 7.4

Teachers of both age groups reported that they praised their pupils for increased individual effort more than anything else. Teachers of both age groups adopted this type of praise nearly always. 5^{th} grade teachers focused on this praise and adopted it more frequently than 8^{th} grade teachers. 8^{th} grade teachers praised pupils for improvement of results sometimes and they adopted this praise more than 5^{th} grade teachers. Teachers of both age groups reported that they praised their pupils for better results than others least frequently.

Pupils, overall, did not perceive that their teachers praised them very frequently. They were neutral to happy in appreciating praise. There were wide individual differences in pupils' perceptions of the frequency of teacher praise and feeling happy with that praise. 5^{th} graders perceived that praise adopted in their mathematics classes was effort-based. They perceived that effort-based praise was adopted more frequently than 8^{th} graders. 8^{th} graders perceived that the praise adopted in their mathematics classes was based on absolute-comparison, improvement of own results or effort, although they perceived that results-based praise was adopted more frequently than 5^{th} graders and they appreciated results-based praise more than 5^{th} graders.

Pupils of both age groups preferred teacher praise based on absolute-comparison. Therefore, there might be some incompatibility between pupils' perceptions of the reasons for teacher praise and the preferred reasons for teacher praise, especially for 5^{th} graders. This incompatibility might occur due to pupils' misunderstanding of the teacher's intentions. Although 5^{th} graders perceived that teacher praise based on more effort than others was adopted as frequently as teacher praise based on individual improvement of effort, 5^{th} grade teachers reported that this praise was much less frequently adopted than the other. Although 8^{th} graders perceived that teacher praise based on better results than others was adopted more than 5^{th} graders, their teachers reported avoiding this type of praise. Perhaps teachers are reluctant to admit giving result based praise as it does not fit well within Japanese educational culture.

Correlations revealed that pupils of both age groups and 8th grade teachers perceive that teachers adopt praise in an integrated way. 5th grade teachers perceived that they give each kind of praise separately. Pupils who appreciated receiving praise, overall, felt happy with praise of any kind, while 5th graders reported being happy with their teacher's praise based on results only when they perceived that their teachers regularly adopted this kind of praise.

Pupils of both grades perceived more frequent deployment of most teaching methods, as they perceived more frequent receipt of praise and felt happy with that praise, although there were some exceptions. Pupils' perceived frequency of deployment of *Reading a textbook* and *Individual work* at both grades and 5th graders' perceived frequency of deployment of *Teacher explanation* was not statistically significantly different according to perceived frequency of teachers' praise, irrespective of the kind of praise.

The effects of pupils' feeling happy with teacher praise on pupils' perceived frequency of deployment of teaching methods was different to the effects of perceived frequency of teacher praise. 5th graders who felt happy with teacher praise based on comparison with others perceived more frequent deployment of *Teacher explanation* and individualised teaching methods. 5th graders who felt happy with teacher praise based on individual improvement perceived more frequent deployment of all teaching methods except for *Using a computer.* 8th graders who felt happy with receiving teacher praise, overall, were not affected in their perceived frequency of deployment of *Using a computer.* Their feeling happy with teacher praise based on better results than others did not affect the perceived frequency of deployment of *Practical work* and *Group discussion.*

Pupils of both grades perceived that positive affective attitudes to mathematics were promoted by all teaching methods, when they perceived more frequent receipt of praise and felt happy with teacher praise, although there were some exceptions. 5th graders' perceived frequency of teachers giving praise did not appear to affect their affective attitudes promoted by *Using a computer* and individualised teaching methods. Their feeling happy with teacher praise did not affect their positive affective attitudes perceived as being promoted by *Using a computer.*

Pupils' perceived frequency of teacher praise appeared to affect their affective attitudes more at 8th grade than 5th grade. However, 8th graders' enjoyment promoted by *Practical work* and *Using a computer* were not affected by the perceived frequency of teacher praise. 8th graders' enjoyment was less affected by their happiness with teacher praise than other aspects of affective attitudes. Their enjoyment promoted by *Practical work* was not affected by the degree of appreciation of teacher praise based on getting better results than others. Their enjoyment promoted by *Reading a textbook* was not affected by the degree of appreciation of teacher praise based on more effort than others. Their enjoyment promoted by *Individual work* was not affected by the degree of appreciation of teacher praise based on increased effort.

This study did not examine the relationships between teachers' reported frequency of adoption of praise and their perceptions of the effects of or deployment of teaching methods, due to teachers' predominant adoption of praise for pupils based on the enhancement of effort.

7.5: Multiple regression

Factors contributing to pupils' mathematics self-concept

Providing a more all encompassing analysis, this section explores the factors which contribute to pupils' mathematics self-concept by means of a stepwise multiple regression. The analysis was conducted separately for pupils of different age groups with differing perceptions of succeeding or failing in mathematics learning, because the data were in this form. Pupils perceiving their mathematics learning as successful were those who graded themselves above 3 in the five point rating of perceived mathematics performance, while pupils perceiving their mathematics learning as failing graded themselves as 1 or 2. Pupils' mathematics self-concept was highly correlated with their perceived mathematics performance (5th grade: r=. 713, p=. 000; 8th grade: r=. 675, p=. 000). This was therefore used as the dependent variable. The variables included in the stepwise multiple regression were: pupils' general self-concept, perceptions of classroom ethos; perceived frequency of different types of teachers' praise; the extent of feeling happy with different kinds of praise; attribution of mathematics performance; perceived frequency of the deployment of different teaching methods; and affective attitudes promoted by different teaching methods. These were regressed on mathematics self-concept.

The responses of 1219 5th graders perceiving their mathematics learning as successful were used in the analysis. For them, perceived satisfaction in the classroom predicted their mathematics self-concept best. General self-concept, deployment of *Teacher explanation* and *Whole-class discussion*, sense of security promoted by *Individual work*, motivation promoted by *Individual help*, attribution of success to ability and perceived competition in classroom predicted their mathematics self-concept positively to a lesser extent. Attribution of success to luck or teacher support and deployment of *Individual help* made a negative contribution to predicting pupils' mathematics self-concept.

The most distinctive finding was that the perceived frequency of the deployment of *Individual help* affected mathematics self-concept inversely, while motivation promoted by this teaching method affected mathematics self-concept positively. The Multiple R value was .570 and the adjusted R square was .318 ($F=41.959$, $p<.01$). See Table 7.5.1 for details.

Table 7.5.1: The multiple correlation coefficient of stepwise multiple regression of 5th graders perceiving their mathematics learning as successful

	Unstandardised coefficient		Standadised Coefficients		
	B	Std.Error	Beta	t	Sig.
(Constant)	.699	.089		7.864	.000
Satisfaction	.123	.009	.374	13.279	.000
Sense of security: Individual work	3.302E-02	.011	.089	3.002	.003
Deployment of Teacher explanation	7.969E-02	.015	.156	5.455	.000
Attribution: luck	-.267	.050	-.147	- 5.325	.000
Deployment of Individual help	- 5.653E-02	.014	-.116	- 4.146	.000
General self-concept	8.812E-03	.003	.094	3.273	.001
Attribution: teacher support	-.108	.033	- .092	- 3.295	.001
Motivation: Individual help	2.916E-02	.011	.078	2.709	.007
Deployment of Whole-class discussion	3.352E-02	.013	.072	2.565	.010
Attribution: ability	.210	.086	.066	2.437	.015
Competition	1.848E-02	.008	.059	2.176	.030

The responses of 260 5th graders perceiving their mathematics learning as failing were analysed, using the same stepwise multiple regression procedure as for students perceiving their learning as successful. For the students perceiving themselves as failing, the perceived frequency of deployment of *Reading a textbook*, perceived satisfaction in mathematics classes, feeling happy with the teacher's praise for better results than others and sense of progress promoted by *Using a computer* positively predicted pupils' mathematics self-concept, although the contributions of each were relatively low. The Multiple R value was .361, the adjusted R square was .112 (ANOVA: F=7.030, p<. 01). See Table 7.5.2 for details. The variables were less successful in predicting the mathematics self-concept of those who perceived themselves as failing.

Table 7.5.2: The multiple correlation coefficient of stepwise multiple regression of 5th graders perceiving their mathematics learning as failing

	Unstandardised coefficient		Standadised Coefficients		
	B	Std.Error	Beta	t	Sig.
(Constant)	.733	.069		10.662	.000
Deployment of Reading a textbook	4.735E-02	.016	.205	2.895	.004
Satisfaction	3.700E-02	.014	.182	2.649	.009
Happy praise for better results than others	2.401E-02	.011	.155	2.228	.027
Sense of progress: using a computer	2.193E-02	.011	.144	2.070	.040

The responses of 1261 8th graders perceiving their mathematics learning as successful were analysed. For pupils perceiving their mathematics learning as successful at 8th grade as at 5th grade, perceived satisfaction was the most important factor predicting mathematics self-concept. General self-concept, enjoyment promoted by *Practical work*, motivation promoted by *Individual work*, attribution of success to ability or task easiness and perceived competitiveness in classroom predicted their mathematics self-concept to a lesser extent. Pupils' attribution of success to luck, perceived difficulty and cohesiveness in a classroom, feeling happy with teacher's praise for enhancement of effort contributed negatively. The Multiple R value was .561, the adjusted R value was .306 (ANOVA: F=39.520, p<. 01). See Table 7.5.3 for details.

Table 7.5.3: The multiple correlation coefficient of stepwise multiple regression of 8th graders perceiving their mathematics learning as successful

	Unstandardised coefficient		Standadised Coefficients		
	B	Std.Error	Beta	t	Sig.
(Constant)	24.023	1.601		15.004	.000
Satisfaction	1.728	.156	.322	11.085	.000
Attribution: ability	6.746	.968	.191	6.971	.000
Attribution: luck	- 3.396	.643	- .149	- 5.285	.000
Difficulty	- .991	.165	- .167	- 6.004	.000
Motivation: Individual work	.783	.174	.124	4.489	.000
General self-concept	.175	.039	.128	4.535	.000
Cohesiveness	- .430	.135	- .093	- 3.187	.001
Attribution: task easiness	2.640	1.077	.067	2.452	.014
Competition	.368	.140	.073	2.634	.009
Happy with praise for enhancement of effort	- .518	.187	- .079	- 2.774	.006
Enjoyment: Practical work	.368	.156	.065	2.367	.018

The responses of 895 8th graders perceiving themselves as failing in mathematics were analysed. Satisfaction was the factor best predicting pupils' mathematics self-concept for 8th graders perceiving themselves as failing at mathematics. General self-concept, enjoyment and sense of progress promoted by *Individual work* and motivation promoted by *Teacher explanation* predicted their mathematics self-concept to a lesser extent. Attribution of failure to lack of ability, perceived difficulty in classroom, sense of progress promoted by *Individual help* predicted mathematics self-concept negatively. The Multiple R value was .585, and the adjusted R value was .334 (ANOVA: F=41.247, p<. 01). See Table 7.5.4 for details. The prediction was stronger at 8th grade than 5th grade.

Table 7.5.4: The multiple correlation coefficient of stepwise multiple regression of 8th graders perceiving their mathematics learning as failing

	Unstandardised coefficient		Standadised Coefficients		
	B	Std.Error	Beta	t	Sig.
(Constant)	13.790	1.474		9.353	.000
Satisfaction	1.703	.184	.323	9.267	.000
Attribution: lack of ability	- 3.736	.754	- .162	- 4.957	.000
Enjoyment Individual work	.618	.187	.121	3.295	.001
Difficulty	- .800	.171	- .157	- 4.672	.000
General self-concept	.147	.035	.140	4.251	.000
Sense of progress: Individual work	.645	.199	.121	3.239	.001
Sense of progress: Individual help	- .517	.189	- .093	- 2.733	.006
Motivation: Teacher explanation	.430	.188	.082	2.288	.022

Many factors predicted the mathematics self-concept of 5th graders perceiving their mathematics learning as successful. This was also the case for 8th graders, irrespective of their mathematics performance. On the other hand, the number of factors predicting 5th graders perceiving themselves as failing was fewer and less coherent. Satisfaction was the strongest factor affecting pupils' mathematics self-concept at both grades, irrespective of perceived mathematics performance. General self-concept predicted pupils' mathematics self-concept positively, except in the case of 5th graders perceiving their mathematics learning as failing.

The extent to which pupils perceived that *Individual work* could promote positive affective attitudes predicted mathematics self-concept positively. For 5th graders perceiving their mathematics learning as successful *Individual help* was seen as promoting their motivation. However, for 8th graders perceiving their mathematics learning as failing, the extent to which they perceived *Individual help* as promoting sense of progress predicted their self-concept negatively. For 8th graders perceiving their mathematics learning as successful, the extent to which *Practical work* was perceived to promote enjoyment predicted mathematics self-concept positively. For 8th graders perceiving their mathematics learning as failing, perceptions of the extent to which *Teacher explanation* promoted motivation affected mathematics self-concept positively.

Perceived frequency of deployment of *Teacher explanation* and *Whole-class discussion* predicted self-concept positively, while perceived frequency of deployment of *Individual help* predicted it negatively for 5th graders perceiving their mathematics learning as successful. Perceived frequency of deployment of *Reading a textbook* positively predicted mathematics self-concept of 5th graders perceiving their mathematics learning as failing. Pupils' perceived frequency of deployment of any teaching method did not predict mathematics self-concept for 8th graders.

Attributing success in mathematics learning to ability predicted positively and attributing it to luck negatively the mathematics self-concept of pupils perceiving their mathematics learning as successful at both grades. Attributing it to teacher support predicted 5th graders' mathematics self-concept negatively, but not that of 8th graders. Attributing it to task easiness predicted 8th graders' mathematics self-concept, but not 5th graders'.

Attributing failure in mathematics learning to lack of ability predicted the mathematics self-concept of 8^{th} graders perceiving their mathematics learning as failing.

Perceived competition in class positively predicted the mathematics self-concept of pupils perceiving their mathematics learning as successful. Perceived difficulty in mathematics learning negatively predicted mathematics self-concept of 8^{th} graders, but not 5^{th} graders. Perceived cohesiveness in mathematics classes negatively predicted mathematics self-concept of 8^{th} graders perceiving their mathematics learning as successful.

The effects of pupils' perceptions of teachers' praise on their mathematics self-concept was evident for 5^{th} graders perceiving their mathematics learning as failing and 8^{th} graders perceiving their mathematics learning as successful, but the effect was small.

Factors predicting teachers' attempts to positively enhance their pupils' mathematics self-concept

The factors predicting teachers' attempts to enhance their pupils' mathematics self-concepts were explored by means of a stepwise multiple regression. The analysis was conducted for teachers of each age group separately. The factors included in the stepwise multiple regression were: the extent to which teachers attempted to enhance pupils' general self-concept; their perceptions of classroom ethos; their reported adoption of different kinds of praise; the perceived frequency of the deployment of different teaching methods; and their perceptions of the extent to which affective attitudes were promoted by different teaching methods. As the majority of teachers attributed mathematics performance to their pupils' effort, this factor was not included in the multiple regression, as it would not have the power to differentiate.

Table 7.5.5: The multiple correlation coefficient of stepwise multiple regression of 5th grade teachers

	Unstandardised coefficient		Standadised Coefficients		
	B	Std.Error	Beta	t	Sig.
(Constant)	- .827	.628		- 1.317	.197
Improving General self-concept	.731	.077	.794	9.450	.000
Notion of friction	.306	.101	.245	3.042	.005
Sense of progress promoted by Practical work	.254	.101	.203	2.515	.017
Motivation promoted by Practical work	- .391	.094	- .358	- 4.141	.000
Enjoyment promoted by Practical work	.432	.143	.268	3.020	.005

The responses of 48 5th grade teachers were analysed. The Multiple R value was .907, the adjusted R value was .795 (ANOVA: F=28.858, p<. 01) (see Table 7.5.5). The responses of 42 8th grade teachers were analysed. Table 7.5.6 showed that the Multiple R value was .924, and the adjusted R value was .822 (ANOVA: F=26.404, p<. 01) (see Table 7.5.6).

Table 7.5.6: The multiple correlation coefficient of stepwise multiple regression of 8th grade teachers

	Unstandardised coefficient		Standadised Coefficients		
	B	Std.Error	Beta	t	Sig.
(Constant)	3.048	.600		5.079	.000
Improving General self-concept	.675	.106	.639	6.340	.000
Praise based on more effort than others	.121	.058	.180	2.094	.046
Sense of security promoted by Individual work	- .199	.087	- .173	- 2.300	.029
Enjoyment promoted by Individual work	- .359	.101	- .276	- 3.568	.001
Sense of security promoted by Whole-class discussion	- .288	.100	- .234	- 2.891	.007
Improving pupils' satisfaction	.247	.102	.259	2.422	.022

The variables were highly successful in predicting teachers' attempts to promote pupils' mathematics self-concept, at both grades. In both cases, for 5th and 8th grade teachers, the extent to which they attempted to enhance their pupils' mathematics self-concept was strongly predicted by the extent of their attempting to enhance pupils' general self-concept at both grades. The extent of teachers attempting to improve pupils' satisfaction in the classroom positively predicted enhancing pupils' mathematics self-concept at 8th grade, while teachers' perceptions of friction in the classroom was a positive predictor at 5th grade. 5th grade teachers attempting to enhance pupils' mathematics self-concept believed that *Practical work* could promote pupils' enjoyment and sense of progress positively but motivation negatively. 8th grade teachers attempting to enhance pupils' mathematics self-concept believed that *Individual work* and *Whole-class discussion* had a negative effect on at least some aspects of pupils' affective attitudes. The perceived frequency of praise being given based on the pupils making more effort than others was a positive predictor for 8th grade teachers, but not for 5th grade teachers.

Teachers' attempts to promote pupils' mathematics self-concept seemed strongly related to their attempts to promote pupils' general self-concept at both grades. The other factors were much weaker predictors. For 5th grade teachers, *Practical work* in relation to its effects on affect was both a positive and negative predictor.

7.6: Summary of Chapter 7

There were developmental differences in pupils' perceptions of self, motivational orientation and classroom ethos. There were also wide individual differences. Pupils' perceived mathematics performance and some aspects of classroom ethos deteriorated in some sense, as they proceeded through the grades.

Pupils' perceived mathematics performance deteriorated as they proceeded through the grades, although mathematics self-concept and general self-concept measured through SDQ-I and SDQ-II did not change. Pupils' perceived satisfaction in class decreased, although 5th graders also perceived relatively low levels of satisfaction. 8th graders perceived more difficulties in mathematics classes than 5th graders, although the level overall was not very high.

8th graders perceived that their teachers hardly ever praised them, although they reported being neutral to happy when they were praised. This phenomenon was also found in 5th graders. The evidence suggested that pupils' perceptions of teacher praise moved from that based on effort at elementary school to individual improvement at 8th grade. In addition, 8th graders more than 5th graders perceived that their teachers adopted results-based praise. They appreciated results-based praise more than 5th graders. They also perceived that teachers praised them for improvement in results more than getting better results than others and they preferred this. 5th graders perceived more than 8th graders that their teachers adopted effort-based praise, but pupils' preference for effort-based praise was not significantly different between the age groups.

The evidence revealed that 8th graders had incremental theories of intelligence, and valued effort in learning. Most 8th graders expressed absolute agreement or agreement that they could do almost anything that they wanted to do if they really tried hard. Both 8th graders perceiving their mathematics learning as successful and those perceiving their mathematics learning as failing gave effort-based attributions. Many 5th graders who perceived their mathematics learning as failing attributed their failure to lack of ability, so it is remarkable that 60% of 8th graders perceiving that their mathematics learning was failing attributed their failure to lack of effort.

Pupils at both ages held perceptions of moderate levels of cohesiveness in class. Friction in classrooms was negligible. Perceived competitiveness decreased in 8th grade.

Pupils' perceptions of self, and some aspects of classroom ethos were correlated; some highly, others moderately. Pupils' mathematics self-concept and perceived mathematics performance were highly correlated, while their general self-concept was moderately correlated with their mathematics self-concept and perceived mathematics performance at both grades. Satisfaction in mathematics classes and perceived cohesiveness were moderately correlated at both grades. Friction and competitiveness were moderately correlated at 5th grade, but not at 8th grade.

Pupils' perceived frequency of teacher praise was relatively highly correlated with types of teacher praise in an integrated way. 5th graders seemed to appreciate teacher praise based on results when they perceived that their teacher tended to adopt this kind of praise, while 8th graders had a more integrated appreciation. This might indicate that 5th graders have not developed abilities to evaluate themselves based on comparisons with others, but that they might come to be conscious about comparisons with others when they perceive that their teachers encourage them to do so.

Teachers of both age groups reported that they attempted to enhance pupils' general self-concept and mathematics self-concept sometimes; their attempts to enhance these two aspects of self-concept were correlated. Effort-based attribution of pupils' success and failure was found in teachers at both grades. Teachers of both age groups reported attempting to improve satisfaction and cohesiveness and reduce difficulties in mathematics classes sometimes. They hardly ever noted friction and slightly disagreed that competition could be used for the promotion of pupils' motivation to learn mathematics. Their attempts to improve satisfaction and their attempts to reduce difficulties were moderately correlated. Teachers of both age groups focussed on an enhancement of effort in pupils.

The difference in perceptions of the teacher groups was relatively smaller than that of the pupils'. 5th grade teachers' attempts to improve cohesiveness and satisfaction, and improve cohesiveness and reduce difficulties were correlated. These correlations were not found in 8th grade teachers. 5th grade teachers reported that they praised their pupils for increased effort more than 8th grade teachers, while 8th grade teachers reported that they praised their pupils for individual improvement of results more than 5th grade teachers. 5th grade teachers adopting result-based praise were likely to do so based on both relative and absolute comparison, while 8th grade teachers seemed to praise their pupils in a more integrated way.

There were differences between the perceptions of teachers' and pupils' regarding praise. It may be that pupils misunderstand teachers' intention in the classroom. Pupils perceived that their teachers praised them based on comparisons with others, despite preferring being praised for individual improvement. 5th graders perceived that their teachers praised them when they made more effort than others. 8th graders perceived that getting better results than others pleased their teachers. Teachers of both age groups reported focusing on praising pupils for enhancement of effort. Teachers believed that pupils who tried hard to learn mathematics could succeed, but those who lacked effort would fail. However, as many 5th graders perceiving their mathematics performance as failing attributed their results to lack of ability as those attributing it to lack of effort.

Teachers and pupils shared similar perceptions of classroom ethos, for instance low levels of friction in classes. Pupils satisfaction and perceived cohesiveness in a class were correlated. Data from 5th grade teachers supported that; in addition, they perceived that improving cohesiveness in the class led to a reduction of difficulties, and vice versa. Teachers of both age groups perceived that improvement of satisfaction was related to the reduction of difficulties. However, this relationship was not found in pupils' responses.

Pupils' general self-concept, mathematics self-concept, perceived mathematics performance, satisfaction in class, perception of cohesiveness in class, perceived frequency of being given teacher praise and their appreciation of teacher praise, overall, had a positive effect on their perceived frequency of deployment of teaching methods and their perceptions of affective attitudes towards mathematics learning promoted by different teaching methods. Conversely, perceived difficulty, overall, led to negative effects. Perceived friction and competitiveness in a class were less likely to affect pupils' affective attitudes towards mathematics learning promoted by different teaching methods. 5^{th} graders with higher perceived mathematics performance and perceiving higher competitiveness perceived a low frequency of receiving individual help. Satisfaction, perceived cohesiveness, perceived frequency of teacher praise and appreciation of teacher praise affected pupil perceptions of the effects of and deployment of different teaching methods more strongly than other aspects at both grades.

Pupils' perceptions of affective attitudes towards mathematics learning promoted by different teaching methods were more strongly affected by their perceptions of self, classroom ethos and teacher praise than the perceived frequency of deployment of the teaching methods. These effects seemed stronger at 5^{th} than 8^{th} grade. For 5^{th} graders, *Using a computer* was the teaching method, which was least affected; followed by individualised teaching methods. For 8^{th} graders, *Reading a textbook, Teacher explanation* and individualised teaching methods were most affected.

Pupils' attribution styles affected the frequency with which they perceived different teaching methods were deployed and their perceptions of the extent to which their affective attitudes were promoted by these teaching methods. In short, pupils' attribution of success to effort, support at school and home, which was the most prevailing attribution style, was positively related to their preference for *Teacher explanation* and *Reading a textbook* at both grades and *Whole-class discussion* and *Group discussion* at 5^{th} grade. Pupils attributing their success to support from the teacher disliked *individual work.* In contrast, pupils attributing their success to ability and task easiness favoured *Individual work*, and disliked *Teacher explanation* and *Reading a textbook*. 5^{th} graders attributing success to task easiness favoured *Practical work* and *Individual work* and *help,* although they perceived less frequent deployment of these teaching methods than those who had other attribution styles. Those attributing success to luck perceived less frequent deployment of all of the teaching methods and less positive affective attitudes promoted by them than those who had other attribution styles. In contrast, pupils' attribution of failure to luck did not cause negative effects compared with other attribution styles. Overall, pupils' attribution style in relation to failure did not have such strong effects as their attribution style for success on their perceptions of teaching methods. However, pupils attributing failure to lack of teacher support did not value the effects of *Teacher explanation* on promoting positive affective attitudes.

Teachers' reported attempts to improve their pupils' self-concept and classroom ethos affected their perceptions of the impact and deployment of different teaching methods, but the effect was limited compared with pupils' responses. 5^{th} grade teachers believed that their attempts to improve their pupils' self-concept and classroom ethos were related to a wide range of teaching methods, while 8^{th} grade teachers' attempts to improve classroom ethos related to a limited number of teaching methods, mainly individual teaching methods. Attempts to improve pupils' satisfaction were positively correlated with their positive perceptions of *Individual help.* Agreement on using competition to promote motivation was positively correlated with positive perceptions of *Individual work*. Attempts to improve class cohesiveness were positively correlated to positive perceptions of *Whole-class discussion*.

Satisfaction in mathematics classes was the strongest factor predicting mathematics self-concept of pupils, irrespective of their age and perceived mathematics performance. Pupils' general self-concept, their perceptions of the extent to which teaching methods could promote affective attitudes, attribution, and perceived classroom ethos all predicted mathematics self-concept. The perceived frequency of teaching methods predicted mathematics self-concept of 5^{th} graders, especially those perceiving their mathematics learning as successful, but not 8^{th} graders. The variables were less successful in predicting the self-concept of 5^{th} graders perceiving their mathematics learning as failing, but moderately successful in predicting the self-concepts of other pupils. The variables were highly successful in predicting perceptions of teachers' attempts to positively promote pupils' mathematics self-concept. The extent of teachers' attempts to promote pupils' general self-concept was the strongest predictor, especially at 5^{th} grade. The effects of other factors were relatively weak.

Chapter 8: IMPLICATIONS AND LIMITATIONS OF THE STUDY

8.1: Summary of the findings

The purpose of this study was to answer three main research questions. In the next section, the three main questions are re-iterated, the findings in relation to each are summarised and the possible reasons for the findings discussed.

Findings regarding Question 1

The first research question was whether teachers and pupils belonging to 5th and 8th grades perceived that pupils' enjoyment, motivation, feelings of security and sense of progress were affected in a similar way by the different teaching methods deployed in mathematics classes. The data to consider this question was obtained from the questionnaire responses.

No deterioration in affective attitudes was found between pupils' in 5th and 8th grade. This contrasts with findings in the USA (e.g. Wigfield et al., 1994, Harter, 1981, 1992). Pupils of both age groups did not perceive that any particular teaching method promoted positive affective attitudes greatly, although there were relatively large individual differences. Overall, this supports the TIMSS data indicating negative attitudes towards mathematics in Japanese students (NIER, 1997, 1998). Overall, pupils' perceptions of the frequency of the deployment of the different teaching methods and the extent to which their affective attitudes were promoted by these teaching methods were consistently lower than their teachers. This reinforces the notion that individuals interpret events in different ways as indicated by Kelly's (1970) personal construct theory, which suggests that individuals construe the same event similarly or differently, because individuals construct corollaries through experience of previous incidents in their lives. People share some constructs (Commonality Corollary), but other constructs are more individual (Individuality Corollary). Although the evidence is clear that pupils and their teachers hold different perceptions, why pupils should perceive the less frequent deployment of particular teaching methods to their teachers is not clear.

Some teachers and pupils preferred traditional teaching methods, i.e. *Teacher explanation*, *Reading a textbook*, *Individual work* and *Individual help*. Others preferred more recently developed teaching methods, i.e. *Practical work, Using a computer, Whole-class discussion* and *Group discussion.* Some teachers, especially 5th grade teachers, held an integrated view of the effects of different teaching methods on pupils' affective attitudes, especially enjoyment and motivation, believing that all teaching methods could have a positive effect. 8th grade teachers were more likely to have dichotomised views of the traditional teaching methods and more recently developed teaching methods.

Recently developed teaching methods, overall, were not frequently adopted at either grade, although *Whole-class discussion* was more often adopted at 5th grade. The reasons for this might be teachers' overall belief that pupils' enjoyment and motivation, as opposed to sense of security and sense of progress as promoted by the majority of the teaching methods investigated were unrelated. This effect was stronger for 8th grade teachers. Overall, teachers believed that the more traditional teaching methods promoted pupils' sense of security and sense of progress more than pupils' enjoyment and motivation. They perceived that the more recently developed teaching methods did not promote pupils' sense of security and sense of progress as much as enjoyment and motivation.

This suggests that teachers' perceptions of pupils' affective attitudes towards mathematics learning do not support motivational theories which indicate that aspects of pupils' affective attitudes are related at least to some extent (e.g. Harter, 1981). The earlier literature (e.g. Mori, 1998; Robitaille, 1989) has indicated that Japanese teachers and parents believe that enjoyment in learning mathematics and being successful may not be related. This was reflected in teachers' perceptions of the effects of the teaching methods in this study. These opinions might have been influenced by the Ministry's attempts in the middle of the 1970s to encourage teachers to adopt discovery and creative teaching methods which were then found to be beneficial for promoting pupils' positive attitudes towards mathematics but not achievement (Saeki, 1978). The teachers may also have some preconceptions of teaching outcomes based on what they have learned during their teacher training course at university and afterwards, their own teaching experiences, government, societal and parental expectations, and recommendations from others, such as the Course of Study and documents written by other teachers. Teachers, who are reluctant to adopt practical activities, might have negative attitudes towards them which may then affect the way they are implemented and their subsequent success.

In contrast to their teachers, pupils from both grades perceived that the attitudinal aspects promoted by each teaching method were related, as the literature suggested. Relationships between pupils' enjoyment and motivation indicated that their motivation in mathematics learning could be internalised as Harter (1992), Deci (1985, 1994), and Bandura (1997) have suggested and linked to successful learning outcomes. 8th graders may find that learning mathematics is enjoyable, even when they are working towards their entrance examination.

Traditional teaching methods were more frequently adopted and preferred at 8th grade than 5th grade. The provision of ample opportunities for learning mathematics individually following teacher explanation was the preferred method for older students. They did not like recently developed teaching methods such as practical work and discussion, which required them to work together. Perhaps pupils prefer what is familiar to them particularly as they get older. The teaching methods adopted in mathematics classes tended to be those methods the pupils preferred particularly at 8th grade.

Recently developed teaching methods were more preferred by pupils at 5th grade than 8th grade. However, overall they were infrequently adopted even at 5th grade. 5th graders' preferred learning methods were not matched with the teaching methods deployed in their mathematics classes. 5th graders perceived that practical work could promote their sense of progress more than enjoyment, perhaps because they (10 year-olds) have not reached Piaget's (1969) defined 'formal operation' stage. In contrast, their teachers perceived that practical work could promote enjoyment and motivation more than sense of security and sense of progress. The difference between pupils' and teachers' views of the effects of practical work on pupils' affective attitudes might be the reason that this teaching method was not frequently adopted, despite pupils' preference for this method. 5th graders did not perceive that individualised teaching methods positively promoted their affective attitudes towards mathematics learning; this may be because interactions with teachers and peers may be more important for elementary school children (e.g.

Shwalb et al., 1985). However, frequent perceived deployment of *Individual work* at 5th grade was related to more positive perceptions of the effects of this teaching method on attitudes.

Teacher Explanation where pupils learn mathematics through interaction with the teacher was preferred by pupils at both grades. In contrast, both teachers and pupils perceived that *Reading a textbook* affected pupils' affective attitudes towards mathematics learning negatively. Pupils' perceived frequency of deployment of *Reading a textbook*, and discussion style teaching methods were correlated with their preference for these methods. Being accustomed to learning mathematics through these teaching methods seems to generate more positive effects on attitudes.

To conclude, teaching methods, which involve active participation are perceived by teachers to promote pupils' enjoyment and motivation more than those which require a more passive learning style. The latter are seen to promote a sense of progress and a sense of security. This is particularly so at 8th grade where there is greater pressure towards being successful in examinations. Pupils tend to like what is on offer with their preferences especially at 8th grade, reflecting their teachers' views regarding enjoyment, motivation, sense of progress and sense of security, although they consistently gave lower ratings than their teachers. There were differences between 5th grade teachers' understanding of the effects of *Practical work* and individualised teaching methods and pupils' preference for these teaching methods. At 8th grade teachers and pupils may have a stronger shared aim, examination success, whereas pupil and teacher aims at 5th grade may be more diverse leading to greater differences in perceptions.

Findings regarding Question 2

The second question considered the factors contributing to pupils' affective attitudes towards mathematics learning. These factors were explored through open questions to teachers of both age groups and 8th graders in the questionnaire. The second question also examines teachers' views of pupils' affective attitudes, teaching methods adopted in mathematics classes and widening a range of teaching methods adopted in mathematics classes. Teachers' views were obtained more fully by interview.

Teachers perceived that the factors contributing to pupils' enjoyment and motivation, and those contributing to pupils' sense of security and sense of progress were different. Encouraging pupils' involvement in mathematics classes and promoting pupils' interest in mathematics classes were perceived to promote pupils' enjoyment and motivation. Meeting pupils' individual needs in mathematics classes and promoting pupils' understanding of the curriculum was perceived to promote pupils' sense of security and sense of progress, although 8th grade teachers mentioned that promoting pupils' understanding of the curriculum promoted enjoyment as well. The teachers' dichotomised views of the factors contributing to pupils' affective attitudes seemed to affect their dichotomised views of the teaching methods. Teachers perceived that recently developed teaching methods contributed to enjoyment and motivation, while traditional teaching methods contributed to sense of security and progress. On the other hand, cohesion was found among 8th graders' perceptions across the factors contributing to four aspects of their affective attitudes. 8th graders perceived that promoting their understanding of the curriculum promoted all four aspects of their affective attitudes.

The Japanese teachers' views challenge findings from the literature (Harter, 1978, 1981; Deci. 1971, 1982, 1992) that pupils' enjoyment, sense of security and sense of progress are related because perceived competence and internal perceptions of control (autonomy) determine pupils' affective attitudes. They also challenge Eccles et al's (1983) expectancy-task value theory that outcome expectancy and task value will promote pupils' motivation to learn mathematics. From the data it seems that teachers believe that pupils' expectancy in mathematics learning contributes to their sense of security and sense of progress, while task value such as interest in learning contributes to enjoyment and motivation. These differences in findings may be due to cultural differences between the USA and Japan. This seems to support Bandura's (1997) theory whereby a sense of personal efficacy is more important than autonomy to maintain motivation for Japanese 8th graders. 8th graders also shared the view with their teachers that having an interest in learning contributed to their enjoyment and motivation.

8th graders believed that involvement in mathematics classes meant adopting a self-reliant learning style where pupils relied on their own effort. This self-reliant learning style is also reflected in the findings that being able to concentrate on the task promoted positive affective attitudes. This may simply reflect generally increased levels of independence as children grow older (Shwalb, 1991), but might support the findings from the literature that pupils' self-reliant learning style has been valued in Japan (e.g. Tanner, 1977; Peak, 1991). Teachers believe that this indicates positive ease of participation. This difference in perception might explain why teachers believe that this factor contributes to pupils' enjoyment and motivation, while pupils believed that this factor contributed to their sense of security and sense of progress.

Teachers of both age groups cited that meeting pupils' individual needs in mathematics classes could promote pupils' sense of security and sense of progress. However, 5th grade teachers expressed their concerns about the negative effects of individual learning on low achievers, despite the fact that they gave considerable *Individual help* to low achievers in class. Although the time allocation of individual learning sessions in mathematics classes increased as the pupils proceeded through the grades, teachers at both grades did not perceive the provision of differentiated materials for each pupil positively. This was chiefly because of egalitarian views of education held in Japan (Tsuneyoshi, R.K. 1991). This contrasts with Western educational thinking which suggests that setting tasks at an appropriate level for pupils promotes positive affective attitudes (e.g. Harter, 1974, 1978, 1981). Few 8th graders indicated that meeting their individual needs was important in positively promoting their affective attitudes.

Few teachers at both grades and 8th graders cited developing pupils' mathematical thinking abilities as positively promoting their affective attitudes, but teachers commented in interviews that the process of developing solutions was more important than finding the right answer. Many teachers perceived that their pupils measured their progress from tangible results, e.g. a correct answer. This was a concern especially for 5th grade teachers, who valued the learning process itself. The Japanese government has suggested that understanding of the curriculum and mathematical thinking abilities are different; the former is indicated by acquisition of fundamental knowledge and skills, while the latter is believed to include intuition, prediction, inference, induction, deduction, examination and expression (Ministry of Education, 1999). The Japanese government has emphasised developing pupils' mathematical thinking abilities rather than understanding of the curriculum for four decades, stimulated by the findings of FIMS in

1967 (Fujii, 1992). However, understanding of the curriculum and developing pupils' mathematical thinking abilities are not orthogonal, rather on a continuum. Developing understanding of the curriculum depends on increased conceptual thinking, such as relating new mathematical conceptual structures to existing knowledge. Entwistle et al (1991, 1992) researching undergraduate students' perceptions of 'understanding' report understanding in terms of breadth, depth and structure. One possible explanation for the findings is that the open questions in the survey might have led pupils into feeling that they had to express their ideas briefly. These short responses allowed the categorisation of participants' perceptions of 'understanding' into 'understanding of the curriculum' and 'developing mathematical thinking abilities'. These categorisations may be superficial.

Some 8th graders cited interactions with peers and the teacher as contributing to promoting positive affective attitudes. This supports the earlier finding that Japanese children think of themselves and accomplishment in terms of relations with others in particular contexts (Hazel et al. 1991; Befu, 1986, Samimy et al. 1994). This did not emerge from the teachers' perceptions as reflected in the open questions. Some teachers mentioned in their interviews that social dynamics, i.e. relationships with teacher and peers, affected pupils' sense of security in mathematics learning. However, teachers put less stress on enjoyment and sense of security than motivation and sense of progress. This might indicate that teachers perceived that the effects of interactions in a class on pupils' positive affective attitudes were relatively weak.

The teaching methods most frequently adopted at 5th grade were not compatible with pupils' preferred teaching methods. However, 5th grade teachers' perceptions of the effects of the teaching methods deployed in mathematics classes were similar to the perceptions of their pupils. Perhaps teachers' perceptions of the effects of different teaching methods affect their pupils' perceptions. 5th grade teachers were likely to perceive that *Practical work* and *Group discussion* positively promoted pupils' affective attitudes more than 8th grade teachers. Teachers lacked confidence in their teaching skills relating to the recently developed teaching methods and stated that lack of resources prevented them from using these methods.

There were wide individual differences in the extent to which different teaching methods were perceived to promote pupils' affective attitudes. Some teachers and pupils preferred traditional methods, while others preferred more innovative methods. The qualitative findings supported the findings from the quantitative data. Teachers of both age groups perceived that promoting pupils' positive affective attitudes towards mathematics learning was important, although teachers perceived that satisfying pupils' enjoyment and sense of security was difficult, because of individual differences, the heavily loaded curriculum, the rigorous entrance examination system and parental concerns about their children's attainments. This was the case particularly at 8th grade, because of the approaching high school entrance examination.

Teachers of both age groups perceived that adopting a variety of teaching methods promoted pupils' cognitive development. Most 5th grade teachers believed that adopting a variety of teaching methods promoted pupils' personal development and allowed for individual differences in learning styles. This reflects the philosophy of education as the development of the whole-person (Cummings, 1980; Lewis, 1995), found in Japanese elementary schools. 5th grade teachers stressed the possible advantages of using a variety of methods as the Ministry of Education in Japan (1999) had suggested. 8th grade teachers did not acknowledge these factors. They stressed that the heavily loaded curriculum meant that time pressure precluded promoting pupils' enjoyment and motivation.

To conclude, 5th grade teachers were more likely to agree with the adoption of various teaching methods and evaluated the recently developed teaching methods more positively than 8th grade teachers. Overall, the qualitative data supported the quantitative findings in that teachers tended to perceive that different teaching methods contributed to enjoyment and motivation as opposed to sense of progress or security. They perceived that meeting individual differences and promoting pupils' understanding of the curriculum were factors contributing to sense of progress or security, while they perceived that positive involvement and interest were factors contributing to enjoyment and motivation. 8th graders suggested that understanding the curriculum promoted all four aspects of attitudes towards mathematics. Lack of confidence in being able to adopt the recently developed teaching methods and lack of resources were also factors which prevented teachers from adopting the recently developed teaching methods. Time limitation was an additional factor at 8th grade. Pupils also stressed the importance of interactions with peers and teachers. For teachers, interaction was not a strong factor contributing to pupils' affective attitudes, although they believed that interaction might be important to ensure pupils had a sense of security.

Findings regarding Question 3

The third question considered the relationships between pupils' attitudes to learning mathematics and whether they were affected by pupils' perceptions of self, classroom ethos and motivational orientations. This question also examined whether there were any differences in perceptions between 5^{th} and 8^{th} grade pupils and their teachers. The data in the questionnaires was used to explore these issues, while teachers' attribution of pupils' success and failure in mathematics learning was explored through open questions.

Teachers of both grades believed that pupil effort was the main factor leading to success in mathematics learning, while pupils failing in mathematics learning did not make sufficient effort. Although the earlier literature has suggested that Japanese teachers might attribute their pupils' poor performance to teachers' lack of instruction skills (Lee at al. 1998), this attribution style was not found in this study. Teachers of both grades praised their pupils for individual enhancement of effort. This suggested that teachers have an incremental theory of intelligence.

5^{th} graders perceived that their teachers praised them for effort, although they did not greatly appreciate being given praise for more effort than others based on their teachers' judgement. They attributed their success in mathematics learning to their effort in learning, support from the teacher and at home, while they attributed their failure to lack of effort or lack of ability. This suggests that not all Japanese 5^{th} graders have an incremental theory of intelligence.

Japanese 8^{th} graders demonstrated stronger incremental theories of intelligence. This supports the findings from the earlier literature showing that Japanese culture values an incremental idea of intelligence (e.g. Kojima, 1986). In 8^{th} graders, their incremental theory seemed to produce effort-based attribution in both success and failure in learning mathematics and their belief in the link between effort and results. 8^{th} graders perceived that their teachers praised them for individual improvement in terms of both effort and results. 8th graders more than 5th graders perceived that their teachers adopted results-based praise. They appreciated these forms of praise. These findings demonstrate stronger incremental theories of intelligence for the older children which contrasts with Western findings that older children are less likely to have incremental theories of intelligence than younger children (Dweck et al., 1983, Dweck, et al. 1988).

Pupils' self-reported mathematics performance decreased and reported difficulties increased from 5th to 8th grades. Pupils' satisfaction within the mathematics classroom was not very high at either grade. 5th and 8th grade teachers' perceptions of pupils' self, motivational orientation and classroom ethos were less different than their pupils. Teachers of both grades believed that reducing pupils' difficulties in mathematics classes would lead to improvement of pupils' satisfaction in the mathematics classes. This relationship was not found in the pupils' responses.

High frequency of deployment of most teaching methods and their positive effects were perceived by pupils with higher general self-concept, higher perceived mathematics performance, high satisfaction in class, high cohesiveness in class, and high levels of frequency of teacher praise and appreciation of teacher praise. Responses to *Using a computer* were least affected by these factors at 5th grade. Traditional teaching methods were more likely to be affected by these factors than recently developed teaching methods at 8th grade. The strongest influences were satisfaction in the mathematics class, perceived cohesiveness, perceived frequency of teacher praise and appreciation of teacher praise. Pupils' perceived difficulty in mathematics classes led to negative responses regarding their perceived frequency of teaching methods and their effects on attitudes.

Pupils' attribution of success to effort and support from the teacher or at home was positively related to their preference for *Teacher explanation* and *Reading a textbook* at both grades and *Whole-class discussion* and *Group discussion* at 5th grade. Those attributing their success to luck perceived less frequent deployment of all of the teaching methods and less positive affective attitudes promoted by them than those who had other attribution styles. In contrast, pupils' attribution of failure to luck did not impact on their perceptions of the deployment of different teaching methods or their effects compared with other attribution styles. This supports Weiner's (1974, 1986, 1992) theory that ascribing positive outcomes to external causes affects academic concepts negatively, but ascribing negative outcomes to external causes does not affect pupils' academic concepts. Pupils attributing their failure to lack of teacher support did not value *Teacher explanation* as promoting positive affective attitudes. For pupils who are not satisfied with teacher's support, a method dominated by the teacher's input may not be well received or trusted.

5th grade teachers believed that their attempts to improve pupils' self-concept and classroom ethos were related to a wide range of teaching methods, while 8th grade teachers' attempts to improve classroom ethos were related to a limited number of teaching methods, mainly individual teaching methods.

The results of the multiple regression of pupil data suggested that pupils' satisfaction in mathematics classes was the strongest factor predicting the mathematics self-concept of pupils, irrespective of their age and perceived mathematics performance. Pupils' satisfaction in mathematics classes was moderately correlated with cohesiveness in the class. Pupils' general self-concept, their perceptions of the extent to which different teaching methods could promote their affective attitudes, their attributions, and perceived classroom ethos all predicted their mathematics self-concept. A multiple regression using the teacher data showed that the extent of teachers' attempts to promote pupils' general self-concept was the strongest predictor, especially at 5th grade. The effects of other factors were relatively weak.

Teachers believed overwhelmingly that effort was the key to pupils doing well. 8th graders demonstrated an incremental theory of intelligence; they attributed success to effort and believed that their effort was reflected in their results. 5th graders also attributed their success to effort, while parental and teacher support were also factors. Pupils who perceived themselves as failing at mathematics generally attributed this to lack of effort although at 5th grade lack of ability was perceived as a key factor. Pupils' attribution of success to effort and support from teacher was related to their preference of *Teacher explanation* and *Reading a textbook,* while their attribution of success to ability and task easiness was related to their preference for *Individual work.*

Although satisfaction was the strongest factor predicting mathematics self-concept and the factor most strongly affecting pupils' affective attitudes towards mathematics learning, pupils at both grades did not report feeling very satisfied in mathematics classes. Although teachers acknowledged the relationships between reduction of difficulties and satisfaction in mathematics classes, reported difficulties increased between 5th and 8th grade. Perceptions of traditional teaching methods were more likely to be affected by self-concept, motivational orientation, perceived classroom ethos and teacher praise and perceived frequency of teaching methods than their perceptions of recently developed teaching methods. Perceptions of *Using a computer* was the least affected teaching method at 5th grade.

Conclusion

5th graders preferred *Practical work* and learning mathematics as a class rather than individually. Their teachers acknowledged this. They evaluated the recently developed teaching methods positively, held a more integrated view of the effects of different teaching methods on pupils' affective attitudes, and admitted that adopting various teaching methods in mathematics classes was beneficial.

However, the reported frequency of the deployment of recently developed teaching methods was still low. This seems to be because teachers believed that enjoyment in mathematics learning was not related to sense of progress. Lack of teacher' confidence and resources were additional obstacles to teaching mathematics through recently developed teaching methods. 8th graders and their teachers, overall, shared the aims of doing well in high school entrance examinations. They perceived that effort was the key factor of success. They preferred traditional teaching methods, which they believed could promote their sense of security and progress. Teachers perceived that sense of security and sense of progress in mathematics classes were not related to enjoyment and motivation as did 5th grade teachers. However, pupils of both age groups perceived that these four aspects were correlated. *Teacher explanation* was the teaching method which pupils of both grades perceived could promote their positive affective attitudes towards mathematics most.

Pupils' perceptions of the effects of teaching methods on their affective attitudes were diverse. Pupils had different preferences for teaching methods according to their attributional style for performance. Their self-concept, motivational orientation, classroom ethos and perceptions of teacher praise affected the perceived frequency of deployment of different teaching methods and their affective attitudes towards mathematics learning. *Using a computer* was the teaching method least affected by these factors at 5th grade. Traditional teaching methods were more likely to be affected by these factors than the recently developed teaching methods at 8th grade. The adoption of various teaching methods can help to meet these individual differences. 5th grade teachers believed that their attempts to improve their pupils' self-concept and classroom ethos were related to a wide range of teaching methods, while 8th grade teachers' attempts to improve classroom ethos related to a limited number of teaching methods, mainly individual teaching methods.

8.2: Limitations

General Issues

The results of the questionnaire survey showed that individual differences existed in pupils' perceptions of the frequency of adopting each teaching method. Pupils may perceive the frequency of adoption of teaching methods differently even in the same class. In other words, pupils' perceived frequency of the adoption of each teaching method does not necessarily reflect the amount of time the teachers spent using a particular method.

Open questions were not adopted in the questionnaire survey with 5th graders, because of the difficulties for them in expressing their ideas in written language coherently. Age differences existed in pupils' perceived frequency of the use of different teaching methods and their preference for different teaching methods. For instance, 8th graders liked individual learning methods, while 5th graders disliked them. Age differences may also exist in perceptions of the factors contributing to affective attitudes towards mathematics learning. This was not explored in the study because of the lack of qualitative data for 5th graders.

Teachers and pupils were asked to report to what extent teachers praised pupils in mathematics classes using five-point rating scales. Pupils were also asked to express the extent to which they felt happy with teachers' praise. Four types of praise were explored (performance vs. effort) x (absolute criteria vs. social comparison with others), as the study aimed to explore perceptions of goal setting reflected in perceptions of teachers' praise. However, teachers might adopt other forms of praise. Pupils might also perceive a wider range of praise or value other types of praise. These issues were not explored in the study.

Pupils' attribution of perceived mathematics performance was measured using a forced choice question. Earlier research by Kashiwagi (1986) reported that Japanese students attributed both success and failure to effort and luck. Japanese children may therefore attribute perceived mathematics performance to several factors in parallel. If this is so, exploring pupils' attribution of their perceived mathematics performance using a forced choice question may be over simplified. Pupils' attribution of perceived mathematics performance in future research could be explored through open questions or on a rating scale to enable more in depth analysis. Teachers' attributions of their pupils' mathematics performance was explored using open questions. As the number of participating teachers was relatively small, in depth analysis could not be conducted.

Limitations in understanding of questions or context

The teaching methods examined in the questionnaire survey were selected according to the recommendations of the Ministry of Education in Japan. The results of the current research showed that some of the teaching methods examined were hardly ever adopted in mathematics classes at the time of research. Thus, participants' replies of the extent to which these teaching methods promoted pupils' affective attitudes were based on expectations rather than their actual experiences. This is clearly a limitation. Further research will be needed to examine whether participants maintain or change their perceptions of teaching methods and their affects when the enactment of the educational report of 2002 occurs which requires change.

Although attempts were made in the pilot study to ensure that terms were understandable, pupils might not have been able to understand what each teaching method as it appeared in the questionnaire sheet indicated and how these related to the teacher's practice in a classroom. This might particularly apply if teachers adopted several teaching methods simultaneously.

Limitations of particular tests

Although the standardised tests such as Marsh's SDQ and Fraser's MCI have already been used in many studies and provide high levels of validity and reliability, using these tests through translation in different cultural contexts from those originally developed might have distorted reliability and validity.

In addition, the adoption of MCI raised further issues. Firstly, some statements requested at the individual level, e.g. 'In my math class everybody is my friend', while other statements referred to the whole class, such as 'Most of the children in my Maths class can do their work without help'. Secondly, MCI may not be sufficiently sensitive to assess Hunt's (1975) Person-Environment Interaction, i.e. learners' perceptions of classroom ethos and their preferred classroom ethos.

Lack of interviews with pupils

In the study interviews were conducted with teachers to provide triangulation whereby different methods are employed to achieve the same aim (Denzin, 1970, in detail Cohen, 2000). However, interviews were not conducted with pupils due to the difficulties of obtaining school and parental permission. The data obtained in the teacher interviews deepened understanding and interpretation of the quantitative data. The lack of pupil interviews precluded this and was particularly acute at 5th grade where the questionnaires did not include open questions.

Lack of observation

This study did not observe actual teaching in mathematics classes. The advantages and disadvantages of observation research and the process of deciding not to adopt observation was described in Chapter 3. The chief reason for avoiding observation lay in the extent to which it could measure participants' attitudes. In addition, generalising the findings obtained through observation of a small sample would have been difficult. However, the findings of this study suggest a need for observation studies to follow up the data on teacher practices. Many teachers reported using several teaching methods. How this is implemented in practice is important for determining future developments.

Generalisability

The current research, which adopted a questionnaire survey, enabled a large sample to be studied. This may assist in the extent to which findings can be generalised. However, the study was conducted in schools, which expressed their willingness to take part. In other words, the sample was 'opportunistic'. This may limit the extent to which generalisations can be made.

Most of the teachers taking part were very interested in developing teaching practices which promoted their pupils' affective attitudes towards mathematics learning. Thus, the findings of this study might not be applicable to all schools in Japan where teachers may be less committed.

While the study was carried out within Japanese culture which has been extensively reported as differing from Western cultures (e.g.Befu, 1986), improving pupils' affective attitudes in mathematics learning and adopting a diversity of teaching methods in mathematics classes appears to be central to the policies of other countries as well (Robitaille, 1997; DES, 1992; Commission on Standards for School Mathematics, 1989; Alexander et al., 1992). While some of the findings here may not generalise to other cultures some may enable an increased understanding of how external factors influence teaching and learning.

Reliability and validity

This study depended largely on quantitative data assessed by five-point rating scales with a large sample. Statistical analysis using large samples tends to produce more easily statistically significant results and there is also an increased risk of Type 1 errors where multiple analyses are undertaken. Therefore, the probability $p<.01$ was used rather than $p<.05$. Multivariate analysis of variance could have been used in some cases but the data and the analysis required were not always well suited to this particularly where there were differences in sample size.

8.3: The educational significance of the findings for teachers and government

8.3.1: The educational significance of the findings for 5th grade teachers

What are the implications of the findings for 5th grade teachers? Firstly, they should take account of their pupils' teaching method preferences in mathematics classes in planning their teaching. Some incompatibility was found between the teaching methods adopted in mathematics classes and 5th graders' preferences for these methods. Teachers should adopt *Practical work* more frequently with greater confidence as the pupils perceived that this promoted their sense of progress in addition to other aspects of enjoyment. Teachers should not be biased by their perceptions of the effects of this method, i.e. that it only promotes enjoyment.

5th grade teachers should also consider the extent to which they adopt the practice of *Individual work.* This teaching method was reported as being adopted relatively often, but it was not preferred by 5th graders chiefly because of the extent to which it limited teacher-pupil interactions. However, the pupils came to like this method more as they became accustomed to it. 5th grade teachers need to explain the value of learning mathematics independently to their pupils to improve their attitudes towards it.

Teachers need to acknowledge that their pupils perceive receiving a lower level of individual support than their teachers intend and that this support seems to be focused on low achievers. The pupils who perceived themselves as good at mathematics and those who perceived high competition in mathematics classes reported a lower frequency of deployment of *Individual help.* Teachers need to consider whether by offering *Individual help* mainly to those in difficulty they are sending particular messages to particular groups of pupils. Individual support could be used to raise the attainment of all pupils.

Teacher explanation and *Whole-class discussion* are the methods which lead to the greatest teacher-pupil and pupil-pupil interactions in learning mathematics. The pupils perceived that these teaching methods could promote positive affective attitudes towards mathematics learning, while the teachers, overall, perceived that listening to teacher explanation was not enjoyable for the pupils because it reduced the opportunity for autonomous learning. The evidence suggests that teachers can use teacher explanation with confidence if they emphasise interactions in the class. The level of interaction is important especially for some 5^{th} graders who attributed support from the teacher as an important factor in their success in mathematics learning. Perceived interactions were also important factors for promoting affective attitudes. Although some 5^{th} grade teachers acknowledged that closer interaction through group discussion promoted pupils' understanding, this teaching method can limit teacher-pupil interaction. Teachers need to consider how they can maintain the attention of individual pupils in a group discussion.

The adoption of *Using a computer* in mathematics classes was greatly affected by the availability of resources. This is clearly an area where considerable development is needed as teaching mathematics through computer use can aid conceptual understanding. The evidence from the study indicated that using a computer was perceived as enjoyable and motivating particularly at 5^{th} grade by pupils who perceived themselves as both good and poor at mathematics. Responses to *Using a computer* were least likely to be affected by 5^{th} grade pupils' self-concept, motivational orientation and classroom ethos suggesting that it would be a particularly appropriate teaching method for low achievers and may increase positive attitudes towards learning mathematics for all pupils. Ways of making full use of the resources need to be found urgently.

There was a wide distribution in the reported frequency of the adoption of *Reading a textbook* and a variety of examples of positive usage and avoidance of this teaching method were given by 5^{th} grade teachers. Teachers should consider how to make the best use of this resource to promote their pupils' understanding. Opportunities for sharing ideas need to be created.

Fifth grade teachers should take account of pupil satisfaction in mathematics classes as this was the strongest factor contributing to pupils' mathematics self-concept. Overall, pupil satisfaction in mathematics classes was not high. Teachers need to improve this. Cohesiveness and satisfaction in mathematics classes were correlated. As young pupils have been observed to experience co-operation and competition in a group (Shwalb et al., 1985a, b), building up good relationships in the class could be a positive way to improve pupil satisfaction.

Fifth grade teachers need to support their pupils in developing effort-based attributions as some pupils attributed their failure in mathematics learning to lack of ability. This could have negative effects on learners' self-esteem and academic self-concept (Weiner, 1974, 1986, 1992; Harnisch et al. 1983; Higuchi et al. 1986; Masuda, 1994, Ito, 1996). Skaalvik (1990) suggested that attributing poor performance to external causes can be a self-serving system for young children. However, few Japanese children attributed failure to external causes such as lack of support from the teacher or at home. This being the case effort based attribution of failure is likely to promote motivation and greater success more than attribution based on ability.

Teachers need to be cautious in assessing the extent of pupil effort through examining pupils' work. Teachers mentioned in the interviews that they valued the learning process more than the learning outcomes. However, mastery learning, which implies that all pupils can achieve certain levels, aims for equality of outcome (Foster et al, 1996). Naturally, teachers assess the effectiveness of their teaching from their pupils' learning outcomes. This may put some children under enormous pressure. Too much emphasis on effort may make some pupils dislike mathematics if they perceive that their learning is a failure (Hosaka, 1989). Some children may require additional support to give them confidence and progress, rather than final attainment, should be positively evaluated. Formative feedback which supports pupils' progress should be given, as the new Course of Study (Ministry of Education, 1999) has suggested.

Fifth grade teachers need to praise their pupils more frequently in order to convey their beliefs about the importance of the personal enhancement of effort. Pupils reported that teachers hardly ever praised them, for any reason. In addition, 5th graders perceived that their teachers praised them for making more effort than others as well as increasing their own efforts. If effort is always praised in comparison with others some pupils may never be praised. Some pupils expressed the view that they did not like being praised. Further research might explore the reasons for this. The perceived differences between teachers' and pupils' perceptions of the giving of praise might be explained by differences in verbal and non-verbal signals given by teachers.

8.3.2: The educational significance of the findings for 8th grade teachers

8th grade teachers need to adopt a broad range of teaching methods. The traditional teaching methods, i.e. listening to teacher explanation, doing individual work and support for that are the methods mainly adopted in mathematics classes at present. Both teachers and their pupils shared the view that these teaching methods could promote pupils' affective attitudes. Teachers seemed to meet pupils' individual needs in teaching mathematics through these methods. However, the methods were more advantageous for certain pupils such as high achievers rather than low achievers. The newer teaching methods, which encourage pupils to learn together, are less affected by pupils' perceptions of self and classroom ethos. Pupils' perceptions of the effect of different teaching methods on their attitudes had a wide distribution. Some preferred traditional teaching methods and others preferred newer teaching methods. Widening the range of teaching methods adopted in mathematics classes should satisfy such individual differences.

Teacher explanation was the teaching method most frequently adopted in 8th grade mathematics classes. The teachers seemed to feel confident in presenting mathematics knowledge clearly to their pupils, although they might have concerns as to the extent to which individual needs for those with a wide range of attainments were satisfied through teacher explanation. Teachers should emphasise teacher-pupil interactions rather than the transmission of knowledge in order to develop pupils' mathematics thinking ability. This is also the case when *Whole-class discussion* is adopted. The frequency of this teaching method decreased as the grades proceeded because of the over loaded curriculum. This situation may be improved through the current educational reform which reduces the curriculum content.

Individual help was given to pupils perceiving themselves as poor at mathematics less than other pupils at 8th grade. Perhaps teachers' attributions of pupils' failure to lack of effort affects the way that they view low achievers and the extent to which they feel able to offer support, as the findings from the literature have suggested (Weiner et al. 1970, 1986; Stahelski et al. 1987; Brophy, 1981). Teachers need to be aware of this and offer increased support to low achievers at 8th grade. Promoting pupils' understanding should be the teachers' main focus, particularly at 8th grade. Pupils reported that promoting their understanding of the curriculum was the strongest factor promoting their positive affective attitudes. This may be because the difficulty perceived by pupils increased in mathematics classes as their grades proceeded. Both teachers and pupils reported that *Individual work* was frequently adopted in their mathematics classes. Teachers should consider how they can provide each individual pupil with tasks at an appropriate level of difficulty, and give them sufficient attention and support in their mathematics classes to promote understanding.

8th grade teachers need to provide tasks, which are interesting and also an environment, which induces concentration, as their pupils reported that they enjoyed working when they were engaged with the task. Teachers need to value pupil satisfaction in mathematics classes. 8th graders did not perceive high satisfaction in mathematics classes despite the fact that satisfaction was the strongest factor contributing to mathematics self-concept. Cohesiveness and satisfaction in mathematics classes were correlated for 8th graders so promoting a supporting learning environment is important. There might be other factors which increase satisfaction for older pupils. Teachers might explore what these are.

8th grade teachers should enable all pupils to experience a sense of progress so that the need for effort becomes meaningful as the earlier literature has suggested. Making effort without a positive outcome expectancy for future tasks leads to children feeling helpless (Sakurai, 1989; Sugiura, 1996). Praising pupils more frequently based on enhancement of effort and giving informational feedback on outcomes is likely to be effective in increasing positive outcome expectancies.

8.3.3: The educational significance for government

If the government wishes new teaching methods such as practical work and using a computer to be adopted extensively in Japanese schools their support is required in providing resources and teacher training. These methods were perceived as hardly ever being deployed at either grade level by pupils or teachers. This was partly due to teachers' lack of confidence in teaching mathematics using these methods and lack of resources, as previous research has suggested (DFE, 1992; NIER, 1995). Enhancing teachers' confidence is important, because previous research has reported that

Japanese teachers believe that improvement of pupils' mathematics performance depends on teachers' effort and skills (Lee et al., 1998).

Overall, both teachers and pupils perceived that reading a textbook had negative effects on enjoyment and motivation, although it was frequently adopted at both grades. One reason for this may be the nature of the textbooks. If textbooks are to be used, they should promote pupils' motivation and enjoyment of mathematics. In this case they may need to be more innovative in their design and modes of presentation. Lepper et al. (1989) indicated that challenge, curiosity and fantasy in materials could promote intrinsic motivation. Textbooks need to be examined in relation to these areas. Textbooks used in Japanese schools are designed to follow the Course of Study and are approved by the Ministry of Education (DFE, 1992; Whitburn, 1995). Textbook development is the responsibility of the government. They need to improve the quality of the texts on offer.

The evidence from the study indicated that the pressure of the curriculum and the high school entrance examination, determined the content and context of learning and teaching. This phenomenon has long been accepted in education and has been called 'backwash' by Biggs (1993). To change the emphasis in teaching would require the introduction of a high school entrance examination, which did not put too much emphasis on the amount of knowledge acquired or the extent of skill development. Introduction of criterion-referenced evaluation, avoiding too strict norm-referenced evaluation has also been perceived to promote pupils' affective attitudes in mathematics learning (e.g. Harter, 1986; Ames, 1992; Wigfield et al. 1994, Kage, 1990). Change of this nature may help 8th graders who have to take high school examinations at the end of 9th grade. Test results are their focus and that of their teachers. Many high schools have already begun to make changes deploying multiple criteria, including school records, recommendations, interviews, short essays, etc (Green, 1998). However, if these measures continue to assess extensive knowledge and skills acquisition retaining the already over loaded curriculum, then achievement focused lessons will continue.

8.4: Conclusions

The most distinct finding as for the adoption of teaching methods in mathematics was that teachers currently tend to hold dichotomised views of the effects of different teaching methods on pupils' attitudes. They most frequently deploy the teaching methods, which they perceive promote pupils' sense of security and sense of progress. This is especially the case at 8th grade. However, adoption of a broad range of methods is important chiefly because it is beneficial for satisfying individual differences. The literature already suggests that teachers believe that the adoption of a broad range of methods is beneficial to satisfy differences in pupils' needs arising from differences in attainment (e.g. Ishida et al., 1986, Kajita et al.1985). This study indicates that it is also beneficial to satisfy individual differences in attitudes.

Pupil satisfaction in mathematics classes should be valued. Although satisfaction was the strongest factor contributing to pupils' mathematics self-concept, satisfaction in mathematics classes was not high at either grade. If pupils' attitudes towards mathematics are to be improved, teachers need to consider a range of factors, which contribute to pupil satisfaction. The teachers need to promote pupils' understanding. The teachers also need to build up good relationships between teacher/pupil and pupil/pupil in mathematics classes. They also need to help pupils with ensuring that they make progress in mathematics learning through effort. In addition, they need to convey the importance of enhancement of individual effort in the learning process to their pupils through praise.

The educational significance for 5th and 8th grade teachers in widening the range of teaching methods is different as examined in the previous section. However, if there is to be real change, teachers of both age groups need to change their aims so that they value positive affective attitudes towards mathematics learning rather than attainment goals alone. In addition, teachers should take time to share their positive beliefs and attitudes towards mathematics learning with their pupils as Brown (1999) has suggested.

In short, to improve pupils' affective attitudes towards learning mathematics, teachers should consider the effective deployment of a range of teaching methods, enhancing the classroom environment, and pupil support, while the Japanese government needs to consider improved teaching training, resources, developing appropriate senior high entrance examinations and textbooks in order to promote the adoption of a diverse range of teaching methods in mathematics classes. Teachers' practices are believed to be greatly affected by their working environments including pressure from their department, institution and community (Biggs, 1993b). These therefore need to change. At the same time, teachers need to use their knowledge of teaching gained from everyday practice to promote change. To promote pupils' affective attitudes towards mathematics learning, effort both 'top-down' and 'bottom up' needs to be made. Consideration also needs to be given to the cultural context, because teachers' and pupils' perceptions of the teaching methods are affected by the cultural and historical backgrounds within which education in Japan is embedded.

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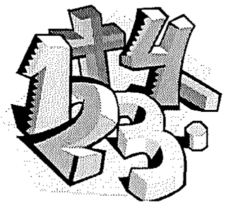
APPENDECIES

5th and 8th grade pupils' and teachers' perceptions of the relationships between teaching methods, classroom ethos, and positive affective attitudes towards learning mathematics in Japan



Questionnaire for 5^{th} graders of elementary school

This is a chance for you to tell us about yourself in your Maths classes. It is not a test. There are no right answers and everyone will have different answers. Your answers will show how you feel about yourself and tell us about the things that you do.

Please do not talk about your answers to anyone else. We will keep your answers private and not show them to any one.

For most of the questions you have to put a tick in a box. Where there is a choice, please put a tick in the small box by the answer nearest to what you think.

Example

	True	*Mostly True*	*Neither*	*Mostly*	*False*
I like to watch TV.					

For this sentence you have to choose the answer that is best for you.
First, you must decide if the sentence is TRUE or FALSE for you, or somewhere in between.

If you really like to watch TV a lot you would answer TRUE by putting a tick in the first box. If you hate watching TV you would answer FALSE by putting a tick in the last box.

If you don't like watching TV very much, but you watch it sometimes, you might decide to put a tick in the box that says MOSTLY FALSE, or MORE FALSE THAN TRUE.

If you want to change an answer you have marked you should cross out the tick and put in another one in the appropriate box.

I. About yourlife and yourself - this is not necessary limited to Mathematics lessons. Please put a tick in the appropriate box.

	True	Mostly True	Neither	Mostly False	False
I do lots of important things.					
In general, I like being the way I am.					
Overall I have a lot to be proud of.					
I can do things as well as most other people.					
Other people think I am a good person.					
A lot of things about me are good.					
I'm as good as most other people.					
When I do something, I do it well.					

II. About mathematics lessons at your school. Please put a tick in the appropriate box.

	True	Mostly True	Neither	Mostly False	False
Work in mathematics is easy for me.					
I look forward to mathematics.					
I get good marks in mathematics.					
I am interested in mathematics.					
I learn things quickly in mathematics.					
I like mathematics.					
I am good at mathematics.					
I enjoy doing work in mathematics.					

III. Why do you think you are good or poor at mathematics?

Please think carefully about your maths lessons this year. In the following questions, write your answers in the large boxes. Where there is a choice, please put a tick in the small box by the answer nearest to what you think.

Do you think you are Very good, Good, OK, Poor, Very poor at Maths you do in school?

Very good	Good	OK	Poor	Very poor

If you chose Very Good, Good or OK

Please choose the reason why you are good at Maths you do in school. *TICK ONLY ONE.*

	I am talented in learning mathematics.
	I try hard to learn mathematics.
	It is just lucky if I do well at Maths classes.
	The instruction of our Maths teacher is very good.
	I have enough support to do well from my parents or juku teachers.
	Tasks and tests are not so difficult in Maths classes.

If you chose Poor or Very Poor

Please choose the reason why you are poor at Maths you do in school. *TICK ONLY ONE.*

	I am not talented in learning mathemaitcs.
	I do not try hard to learn mathematics.
	It is just unlucky if I do not well at Maths classes.
	The instruction of our Maths teacher is not very good.
	I don't have enough support to do well from my parents or juku teachers.
	Tasks and tests are very difficult in Maths classes.

IV. How often do you have these kinds of learning methods in your mathematics lessons?

	Always	Nearly Always	Some Times	Hardly Ever	Never
Practical work Doing practical work in a small group, for example, making something together, doing experiments or investigation.					
Using a computer					
Reading a textbook Reading about something, for instance, explanations in textbooks.					
Teacher explanation Listening to the teacher explaining to the class and the teacher asking the class questions.					
Individaul work Doing individual work such as doing exercises.					
Individual help Individual help: talking to the teacher on your own about your work.					
Whole-class discussion Whole-class discussion where you give ideas and you listen to others giving theirs.					
Group discussion Small-group discussion where you give your ideas and you listen to others giving theirs.					

V. Please give each method a mark out of 5 points. 5 meaning strongly agree, 4 agree, 3 neither agree nor disagree, 2 disagree, 1 strongly disagree.

a. Do these methods help you to enjoy learning mathematics?

Practical work	Using a computer	Reading a Textbook	Teacher explanation	Individual work	Individual help	Whole-class discussion	Group discussion

b. Do these methods encourage you to try hard in mathematics?

Practical work	Using a computer	Reading a Textbook	Teacher explanation	Individual work	Individual help	Whole-class discussion	Group discussion

c. Do you feel relaxed in learning mathematics by using these particular methods?

Practical work	Using a Computer	Reading a Textbook	Teacher explanation	Individual work	Individual Help	Whole-class discussion	Group discussion

d. Do you think these methods help you to feel that you are making progress in learning mathematics?

Practical work	Using a computer	Reading a Textbook	Teacher explanation	Individual Work	Individual help	Whole-class discussion	Group discussion

VI. Please check either appropriate.

	YES	NO
The pupils in my Maths class enjoy their work.		
Children are always fighting each other in my Maths class.		
Children often race to see who can finish first in my Maths class.		
In our Maths class the work is hard to do.		
In my Maths class everybody is my friend.		
Some pupils are not happy in my Maths class.		
Some of the children in my Maths class are mean.		
Most of the children in my Maths class want their work to be better than their friends' work.		
Most of the children in my Maths class can do their work without help.		
Few pupils in my Maths class are my friends.		
Children seem to like this Maths class.		
Many children in this Maths class like to fight.		
Some pupils in my Maths class feel bad when they don't do as well as the others.		
Only certain pupils in my Maths class can do their work.		
All the pupils in my Maths class are close friends.		
Some of the pupils don't like this Maths class.		
Certain pupils always want their own way in my Maths class.		
Some pupils always try to do their work better than the others in my Maths class.		
Schoolwork in Maths class is hard to do.		
All the pupils in my Maths class like one another.		
Maths class is fun.		
Children in my Maths class fight a lot.		
A few children in my Maths class want to be first all the time.		
Most of the pupils in my Maths class know how to do their work.		
Children in our Maths class like each other as friends.		

VII. How often do you praise your pupils, according to the criteria mentioned below? Put number 5-1. 5=always, 4=nearly always, 3=sometimes, 2=hardly every, 1=never.

	When pupils attain good results in Maths tests, compared to other pupils.
	When pupils have imporved results in Maths tests over their previous results.
	When pupils make more effort in Maths, compared to other pupils.
	When pupils make more effort in Maths than they did before.

VIII. To what extent you are happy by getting your teacher's praise in these ways? Put number 5-1. 5=very happy, 4=happy, 3=nutral, 2=unhappy, 1=very unhappy.

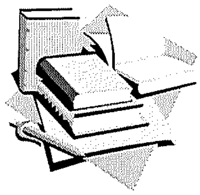
	When pupils attain good results in Maths tests, compared to other pupils.
	When pupils have imporved results in Maths tests over their previous results.
	When pupils make more effort in Maths, compared to other pupils.
	When pupils make more effort in Maths than they did before.

ARE YOU A BOY OR GIRL? [ ] BOY [ ] GIRL

YOUR SCHOOL [ ]
YOUR CLASS NUMBER [ ]

Thank you very much for your co-operation.

[The original version is written in Japanese.]



Questionnaire for
2nd graders of
junior high school

This is a chance for you to tell us about yourself in your Maths classes. It is not a test. There are no right answers and everyone will have different answers. Your answers will show how you feel about yourself and tell us about the things that you do.

Please do not talk about your answers to anyone else. We will keep your answers private and not show them to any one.

For most of the questions you have to put a tick in a box. Where there is a choice, please put a tick in the small box by the answer nearest to what you think.

Example

	True	*Mostly True*	*Neither*	*Mostly*	*False*
I like to watch TV.					

For this sentence you have to choose the answer that is best for you.
First, you must decide if the sentence is TRUE or FALSE for you, or somewhere in between.

If you really like to watch TV a lot you would answer TRUE by putting a tick in the first box. If you hate watching TV you would answer FALSE by putting a tick in the last box.
If you don't like watching TV very much, but you watch it sometimes, you might decide to put a tick in the box that says MOSTLY FALSE, or MORE FALSE THAN TRUE.

If you want to change an answer you have marked you should cross out the tick and put in another one in the appropriate box.

In the large boxes please write about your feelings and opinions.

I. About yourlife and yourself - this is not necessary limited to Mathematics lessons. Please put a tick in the appropriate box.

	True	Mostly True	Neither	Mostly false	False
Overall I have a lot to be proud of.					
Overall I am no good.					
Most things I do, I do well.					
Nothing I do ever seems to turn out rights.					
Overall, most things I do turn out right.					
I don't have much to be proud of.					
I can do things as well as most people.					
I feel that my life is not very useful.					
If I really try I can do almost anything I want to do.					
Overall, I'm a failure.					

II. About mathematics lessons at your school. Please put a tick in the appropriate box.

	True	Mostly True	Neither	Mostly false	False
Mathematics is one of my best subjects.					
I often need help in mathematics.					
I look forward to maths classes.					
I have trouble understanding anything with mathematics in it.					
I enjoy studying for mathematics.					
I do badly in tests of mathematics.					
I get good marks in mathematics.					
I never want to take another mathematics course.					
I have always done well in mathematics.					
I hate mathematics.					

III. Why do you think you are good or poor at mathematics?

Please think carefully about your maths lessons this year. In the following questions, write your answers in the large boxes. Where there is a choice, please put a tick in the small box by the answer nearest to what you think.

Do you think you are Very good, Good, OK, Poor, Very poor at Maths you do in school?

Very good	Good	OK	Poor	Very poor

If you chose Very Good, Good or OK

Please choose the reason why you are good at Maths you do in school. *TICK ONLY ONE.*

	I am talented in learning mathematics.
	I try hard to learn mathematics.
	It is just lucky if I do well at Maths classes.
	The instruction of our Maths teacher is very good.
	I have enough support to do well from my parents or juku teachers.
	Tasks and tests are not so difficult in Maths classes.
	Others [please specify]

If you chose Poor or Very Poor

Please choose the reason why you are poor at Maths you do in school. *TICK ONLY ONE.*

	I am not talented in learning mathemaitcs.
	I do not try hard to learn mathematics.
	It is just unlucky if I do not well at Maths classes.
	The instruction of our Maths teacher is not very good.
	I don't have enough support to do well from my parents or juku teachers.
	Tasks and tests are very difficult in Maths classes.
	Others [please specify]

IV. How ofen do you have these kinds of learning methods in your mathematics lessons?

	Always	Nearly Always	Some Times	Hardly Ever	Never
Practical work: Doing practical work in a small group, for example, making something together, doing experiments or investigation.					
Using a computer					
Reading a textbook: Reading about something, for instance, explanations in textbooks.					
Teacher explanation: Listening to the teacher explaining to the class and the teacher asking the class questions.					
Individual work: Doing individual work such as doing exercises.					
Individual help: talking to the teacher on your own about your work.					
Whole-class discussion: Whole-class discussion where you give ideas and you listen to others giving theirs.					
Group discussion: Small-group discussion where you give your ideas and listen to others giving theirs.					

V. Please give each method a mark out of 5 points. 5 meaning strongly agree, 4 agree, 3 neither agree nor disagree, 2 disagree, 1 strongly disagree.

a. Do these methods help you to enjoy learning mathematics?

Practical work	Using a computer	Reading a Textbook	Teacher explanation	Individual work	Individual help	Whole-class discussion	Group discussion

Why do you think that particular teaching methods allow you to enjoy learning mathematics?

b. Do these methods encourage you to try hard in mathematics?

Practical work	Using a computer	Reading a Textbook	Teacher explanation	Individual work	Individual help	Whole-class discussion	Group discussion

Why do you think particular teaching methods encourage you to try hard in mathematics?

c. Do you feel relaxed in learning mathematics by using these particular methods?

Practical work	Using a Computer	Reading a Textbook	Teacher explanation	Individual work	Individual Help	Whole-class discussion	Group discussion

Why do you think particular teaching methods let you feel relaxed in learning mathematics?

d. Do you think these methods help you to feel that you are making progress in learning mathematics?

Practical work	Using a computer	Reading a Textbook	Teacher explanation	Individual work	Individual help	Whole-class discussion	Group discussion

Why do you think these teaching methods help you to feel that you are making progress in learning mathematics?

VI. Please check either appropriate.

	YES	NO
The pupils in my Maths class enjoy their work.		
Children are always fighting each other in my Maths class.		
Children often race to see who can finish first in my Maths class.		
In our Maths class the work is hard to do.		
In my Maths class everybody is my friend.		
Some pupils are not happy in my Maths class.		
Some of the children in my Maths class are mean.		
Most of the children in my Maths class want their work to be better than their friends' work.		
Most of the children in my Maths class can do their work without help.		
Few pupils in my Maths class are my friends.		
Children seem to like this Maths class.		
Many children in this Maths class like to fight.		
Some pupils in my Maths class feel bad when they don't do as well as the others.		
Only certain pupils in my Maths class can do their work.		
All the pupils in my Maths class are close friends.		
Some of the pupils don't like this Maths class.		
Certain pupils always want their own way in my Maths class.		
Some pupils always try to do their work better than the others in my Maths class.		
Schoolwork in Maths class is hard to do.		
All the pupils in my Maths class like one another.		
Maths class is fun.		
Children in my Maths class fight a lot.		
A few children in my Maths class want to be first all the time.		
Most of the pupils in my Maths class know how to do their work.		
Children in our Maths class like each other as friends.		

VII. How often do you praise your pupils, according to the criteria mentioned below? Put number 5-1. 5=always, 4=nearly always, 3=sometimes, 2=hardly every, 1=never.

	When pupils attain good results in Maths tests, compared to other pupils.
	When pupils have imporved results in Maths tests over their previous results.
	When pupils make more effort in Maths, compared to other pupils.
	When pupils make more effort in Maths than they did before.

VIII. To what extent you are happy by getting your teacher's praise in these ways? Put number 5-1. 5=very happy, 4=happy, 3=nutral, 2=unhappy, 1=very unhappy.

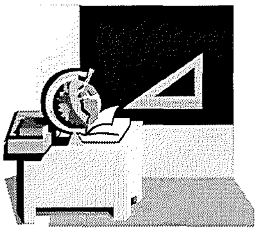
	When pupils attain good results in Maths tests, compared to other pupils.
	When pupils have imporved results in Maths tests over their previous results.
	When pupils make more effort in Maths, compared to other pupils.
	When pupils make more effort in Maths than they did before.

ARE YOU A BOY OR GIRL? [ ] BOY [ ] GIRL

YOUR SCHOOL [ ]
YOUR CLASS NUMBER [ ]

Thank you very much for your co-operation.

[The original version is written in Japanese.]



Questionnaire for mathematics teachers

Please tell us about your opinions about the teaching methods in mathematics classes.

We will keep your answers private and not show them to any one.

For most of the questions you have to put a tick in a box. Where there is a choice, please put a tick in the small box by the answer nearest to what you think. In the large boxes, please write about your feeling and opinions.

I. How often do you have these kinds of learning methods in your mathematics lessons?

	Always	Nearly Always	Some Times	Hardly Ever	Never
Practical work: Doing practical work in a small group, for example, making something together, doing experiments or investigation.					
Using a computer					
Reading a textbook: Reading about something, for instance, explanations in textbooks.					
Teacher explanation: Listening to the teacher explaining to the class and the teacher asking the class questions.					
Individual work: Doing individual work such as doing exercises.					
Individual help: Talking to the teacher on your own about your work.					
Whole-class discussion: Whole-class discussion where you give ideas and you listen to others giving theirs.					
Group discussion: Small-group discussion where you give your ideas and you listen to others giving theirs.					

II. Please give each method a mark out of 5 points. 5 meaning strongly agree, 4 agree, 3 neither agree nor disagree, 2 disagree, 1 strongly disagree.

a. Do these methods help your pupils to enjoy learning mathematics?

Practical work	Using a computer	Reading a textbook	Teacher explanation	Individual Work	Individual help	Whole-clas discussion	Group discussion

Why do you think particular teaching methods enable your pupils to enjoy learning mathematics?

b. Do these methods encourage your pupils to try hard in mathematics?

Practical work	Using a computer	Reading a textbook	Teacher explanation	Individual Work	Individual help	Whole-clas: discussion	Group discussion

Why do you think particular teaching methods encourage your pupils to try hard in mathematics?

c. Do you think your pupils feel relaxed in learning mathematics when you use these particular methods?

Practical work	Using a computer	Reading a textbook	Teacher explanation	Individual Work	Individual help	Whole-clas: discussion	Group discussion

Why do you think particular teaching methods enable your pupils to feel relaxed in learning mathematics by using these methods?

d. Do you think these methods help your pupils to feel a sense of progress in learning mathematics?

Practical work	Using a computer	Reading a textbook	Teacher explanation	Individual Work	Individual help	Whole-clas: discussion	Group discussion

Why do you think these methods help your pupils to feel a sense of progress in learning mathematics?

III. Please check the appropriate box.

a. How often do you attempt to enhance your pupils' satisfaction in learning mathematics?

Always	Nearly always	Sometimes	Hardly ever	Never

b. How often do you attempt to promote co-operative attitudes among pupils?

Always	Nearly always	Sometimes	Hardly ever	Never

c. How often do you attempt to reduce your pupils' difficulties in learning mathematics?

Always	Nearly always	Sometimes	Hardly ever	Never

d. To what extent do you agree that competition can be used to promote pupils' motivation to learn mathematics?

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

e. How often do you notice friction between pupils in mathematics classes?

Always	Nearly always	Sometimes	Hardly ever	Never

IV. Please check the appropriate box.

a. How often do you attempt to enhance your pupils' self-concept?

Always	Nearly always	Sometimes	Hardly ever	Never

b. How often do you attempt to enhance your pupils' positive attitudes towards mathematics learning in your mathematics classes?

Always	Nearly always	Sometimes	Hardly ever	Never

V. How often do you praise your pupils, according to the criteria mentioned below? Put number 5-1. 5=always, 4=nearly always, 3=sometimes, 2=hardly every, 1=never.

	When pupils attain good results in Maths tests, compared to other pupils.
	When pupils have imporved results in Maths tests over their previous results.
	When pupils make more effort in Maths, compared to other pupils.
	When pupils make more effort in Maths than they did before.

VI. Please write your opinion on the question below.

a. Why do you think some pupils succeed in learning mathematics?

b. Why do you think some pupils fail to learn mathematics?

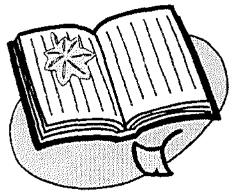
How many years have been working at school? [ ]

GENDER M [ ] F [ ]

SCHOOL [ ]

Thank you very much for your co-operation.

[The original version is written in Japanese.]



Interview sheet for teachers

I: Introduction

First of all, could you explain the teaching pattern you adopt in your mathematics classes?

II. Adoption of teaching methods in mathematics classes

Do you sometimes use practical activities in mathematics classes? Please give me the reasons as well.

Do you use computer in mathematics classes? Please give me the reasons as well.

Do you use the textbooks in mathematics classes? If so, how do you use textbooks in mathematics classes? Please give me the reasons as well.

Do you give pupils the opportunities to do practices individually in mathematics classes? Please give me the reasons as well.

Do you give pupils different tasks according to their attainments in mathematics classes? Please give me the reasons as well.

Do you adopt discussion in mathematics classes? Please give me the reasons as well.

III. Promoting pupils' affective attitudes towards mathematics learning in mathematics classes

Do you think letting your pupils to enjoy learning mathematics is important?

Do you think it is important to keep pupils' motivation to learn mathematics high?

Do you think it is important to let pupils feel secure in mathematics learning?

Do you think it is important to let pupils feel progress in mathematics learning?

When do you think that pupils themselves have a sense of progress in mathematics learning?

When do you feel that their pupils make progress in mathematics learning?

IV. Adopting a various teaching methods in mathematics classes

Could you give me your views about adopting various teaching methods in mathematics classes?

[The original version is written in Japanese.]

Figure 4.4.3: Correlations between teaching methods in terms of promoting pupils' enjoyment: perceptions of 5th graders

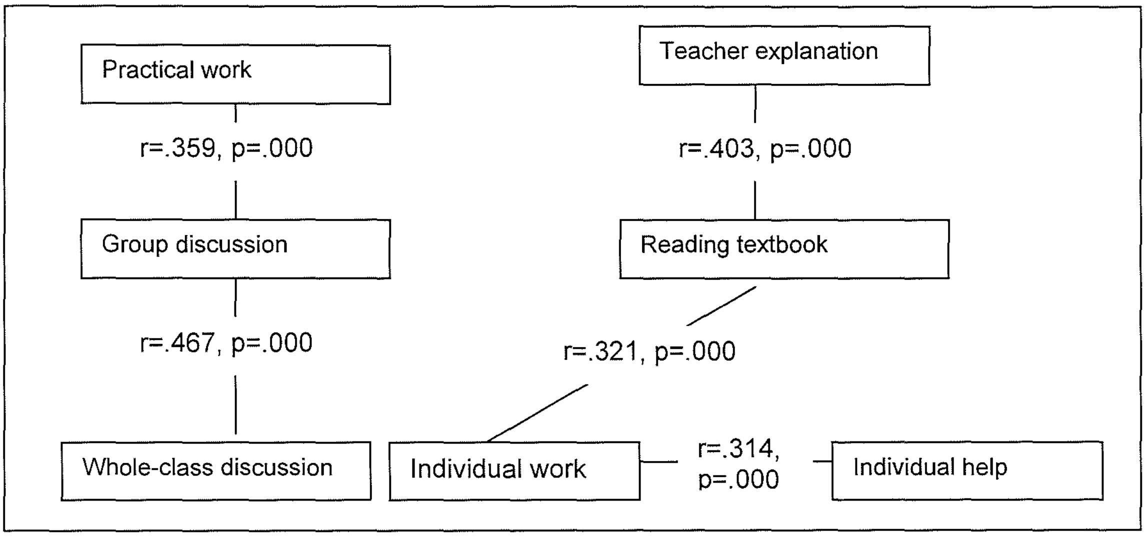


Figure 4.4.4: Correlations between teaching methods in terms of promoting pupils' enjoyment: perceptions of 8th graders

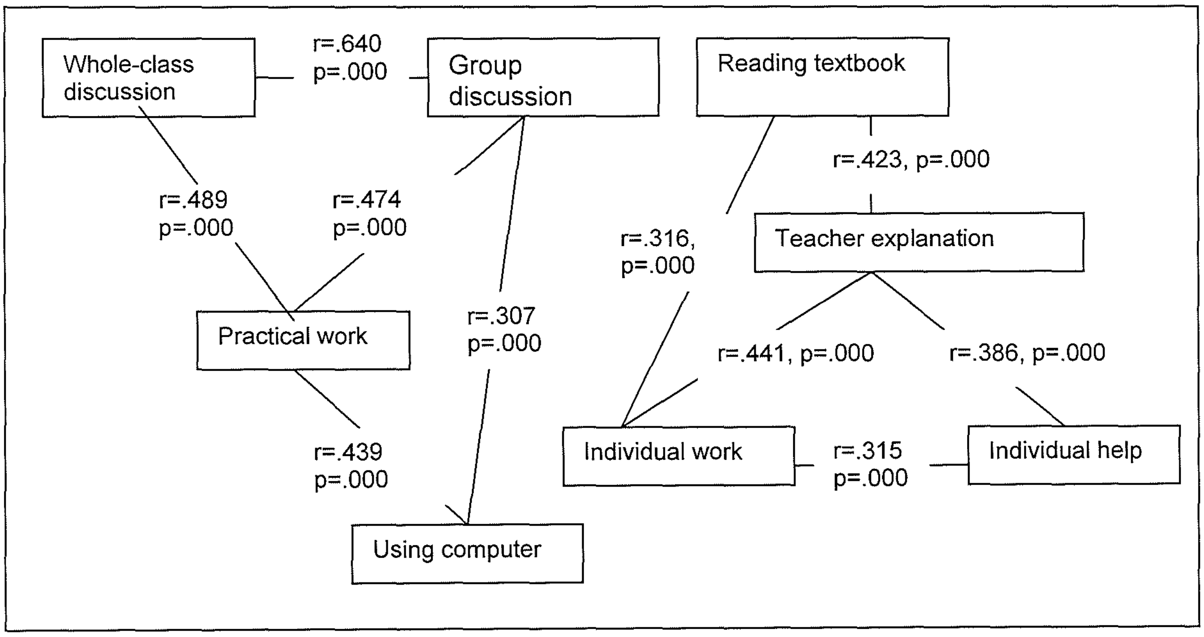


Figure 4.4.6: Correlations between teaching methods in terms of promoting pupils' motivation: perceptions of 8th grade teachers

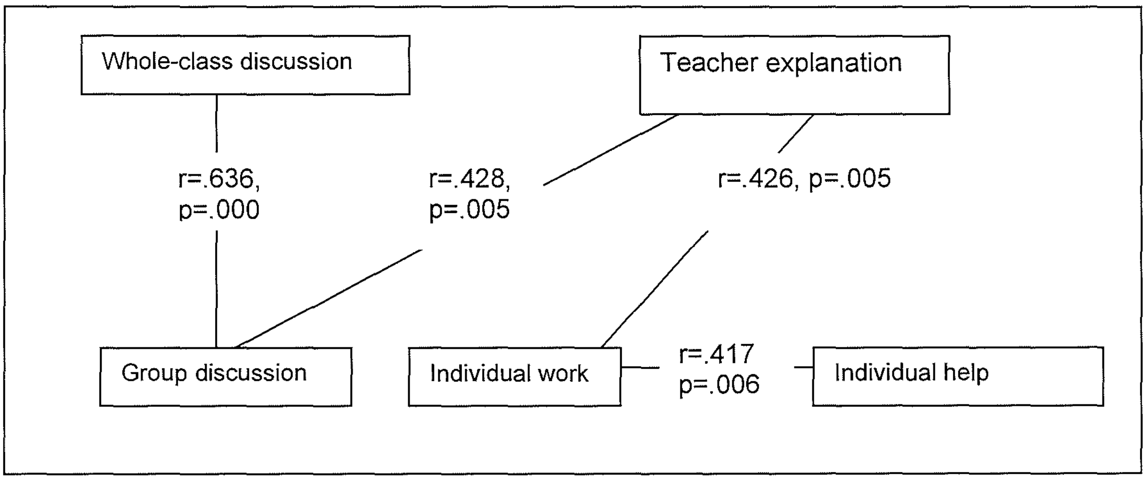


Figure 4.4.7: Correlations between teaching methods in terms of promoting pupils' motivation: perceptions of 5th graders

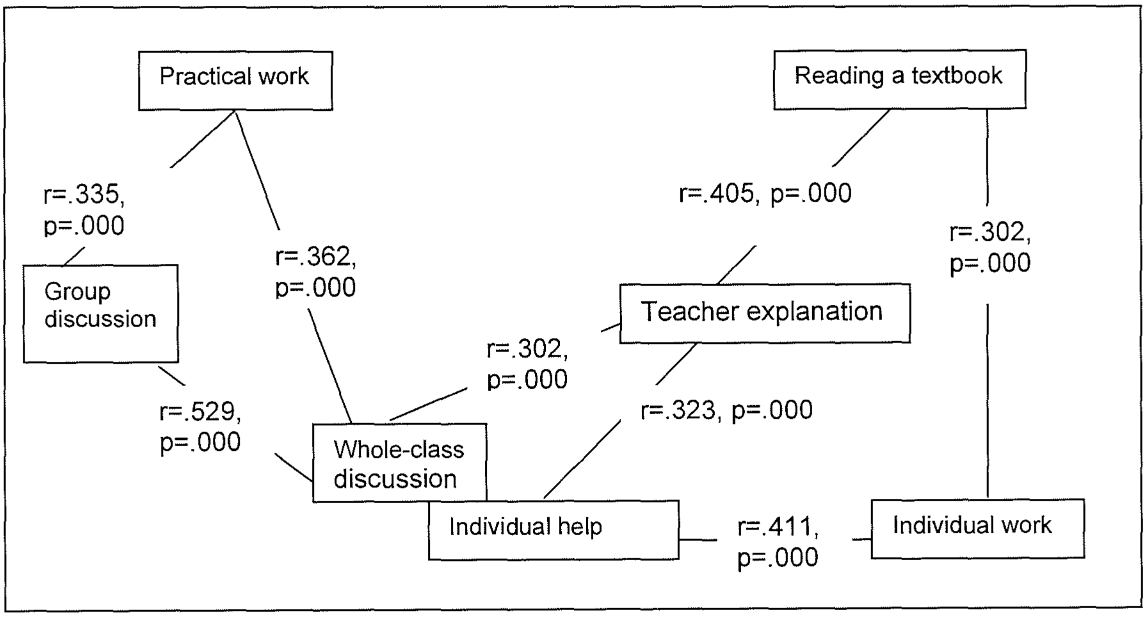


Figure 4.4.8: Correlations between teaching methods in terms of promoting pupils' motivation: perceptions of 8th graders

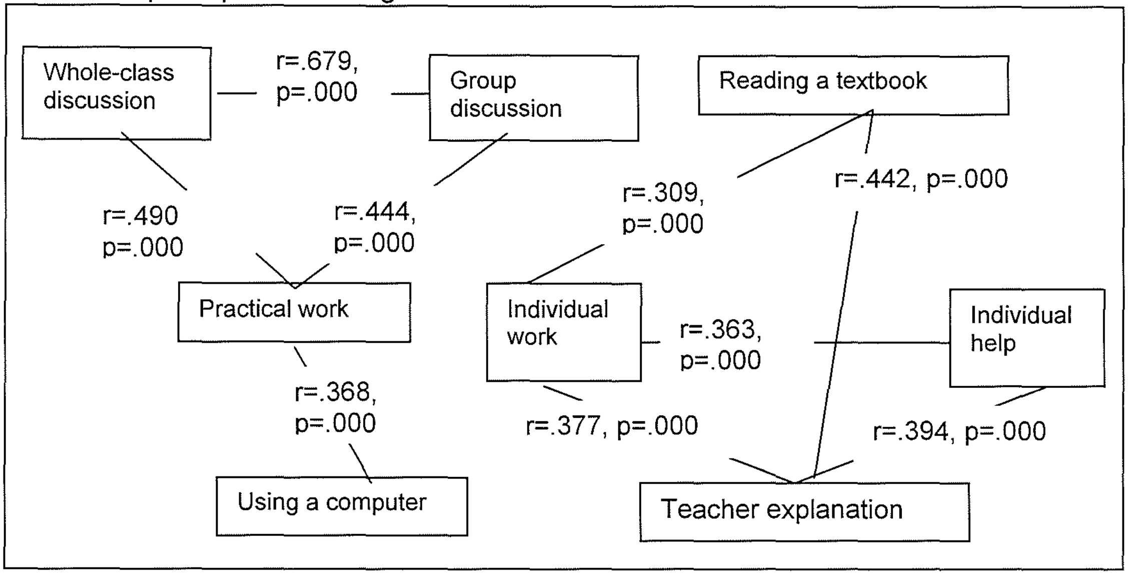


Figure 4.4.9: Correlations between teaching methods in terms of promoting pupils' sense of security: perceptions of 5th grade teachers

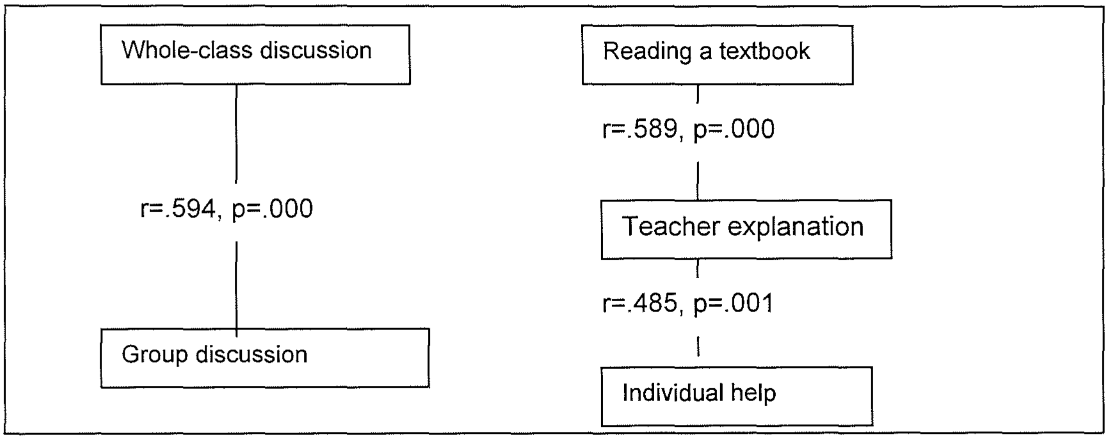


Figure 4.4.10: Correlations between teaching methods in terms of promoting pupils' sense of security: perceptions of 8th grade teachers

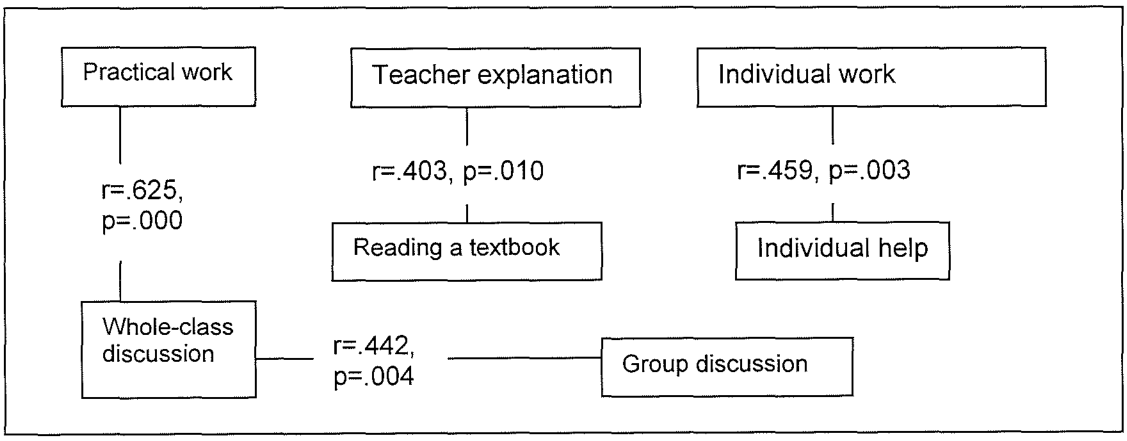


Figure 4.4.11: Correlations between teaching methods in terms of promoting pupils' sense of security: perceptions of 5th graders

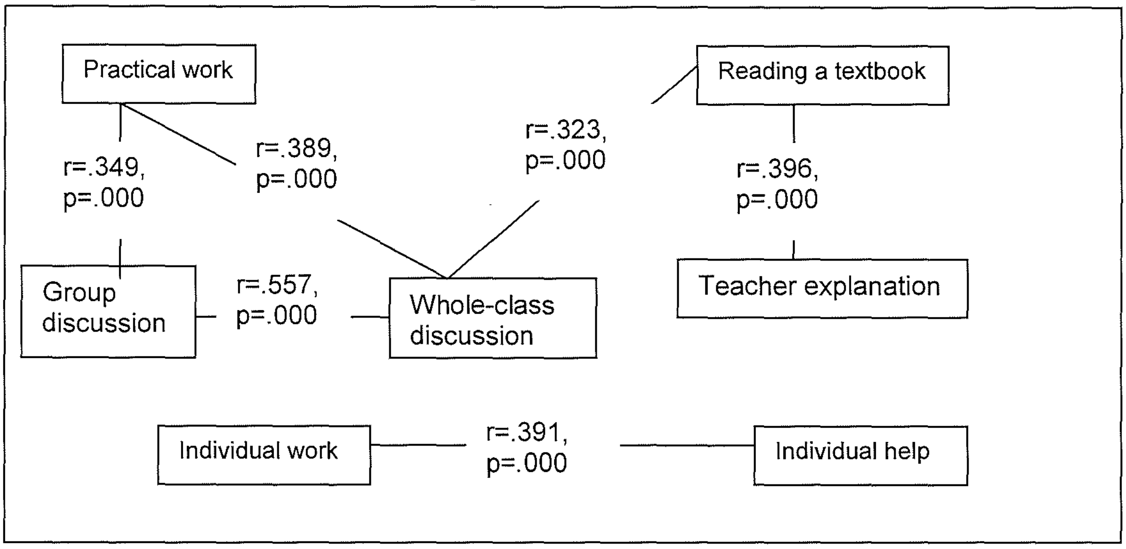


Figure 4.4.12: Correlations between teaching methods in terms of promoting pupils' sense of security: perceptions of 8th graders

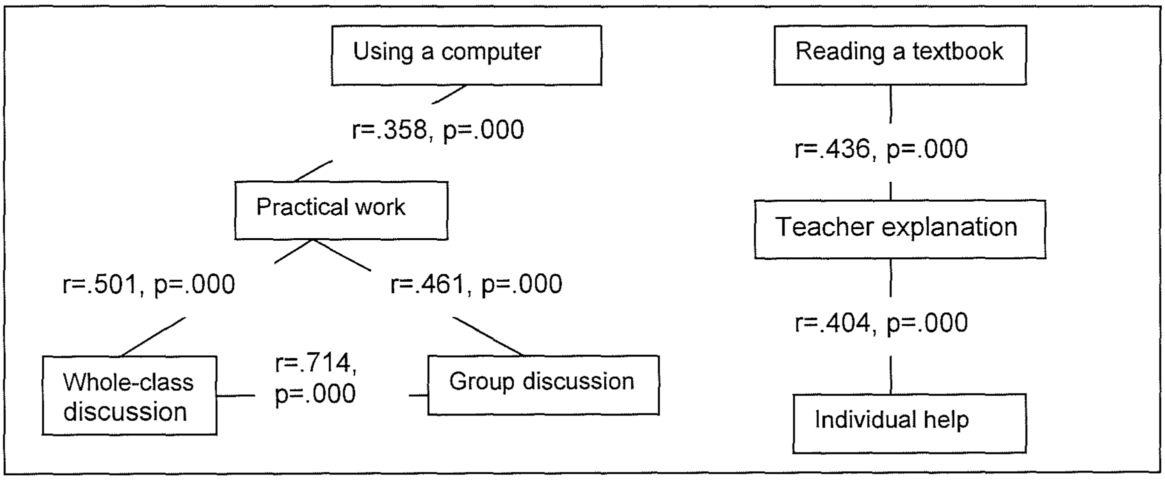


Figure 4.4.13: Correlations between teaching methods in terms of promoting pupils' sense of progress: perceptions of 5th grade teachers

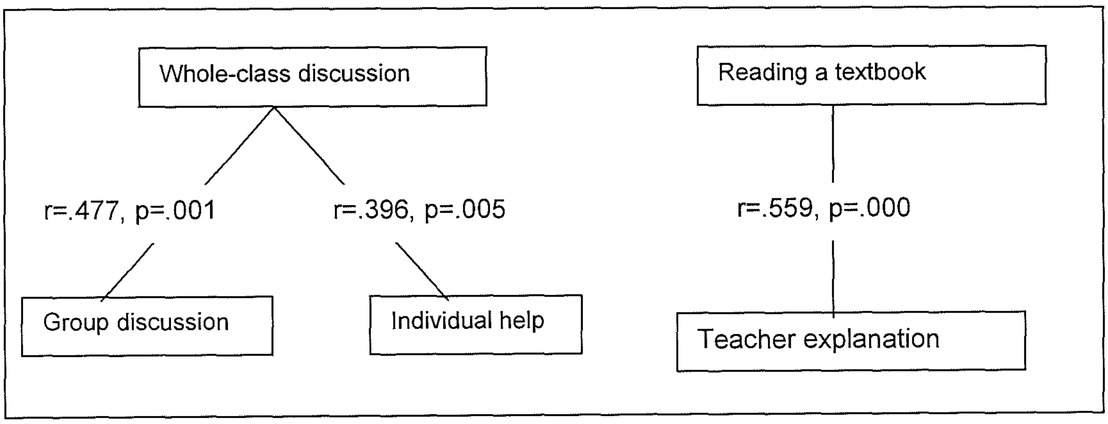


Figure 4.4.14: Correlations between teaching methods in terms of promoting pupils' sense of progress: perceptions of 8th grade teachers

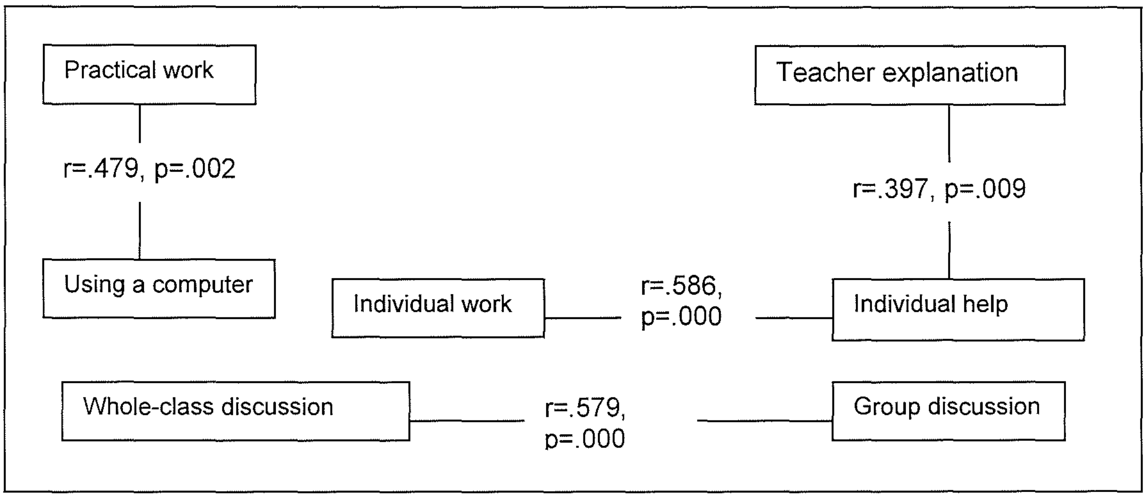


Figure 4.4.15: Correlations between teaching methods in terms of promoting pupils' sense of progress: perceptions of 5th graders

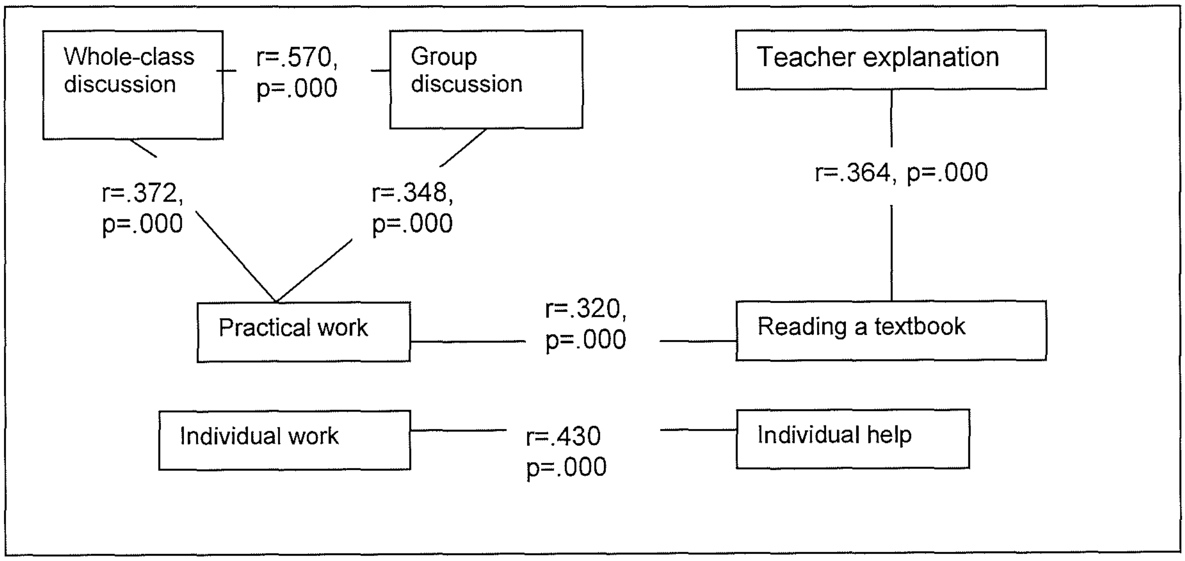


Figure 4.4.16: Correlations between teaching methods in terms of promoting pupils' sense of progress: perceptions of 8th graders

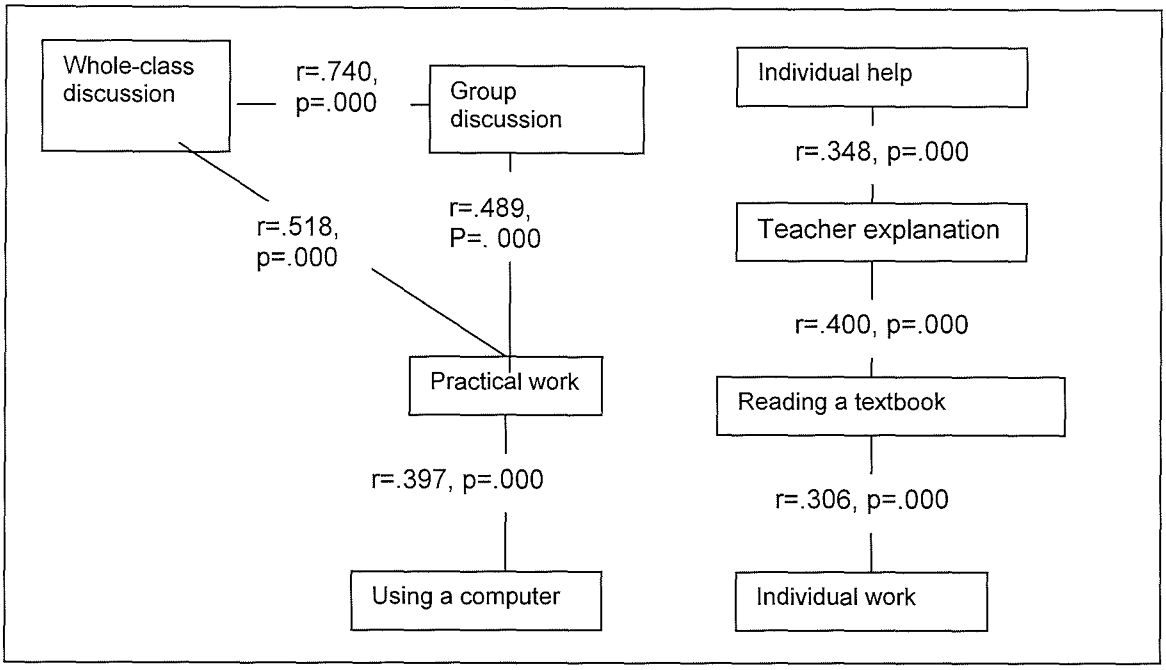


Figure 4.4.18: Correlations between teaching methods in terms of the frequency of the deployment: perceptions of 8th grade teachers

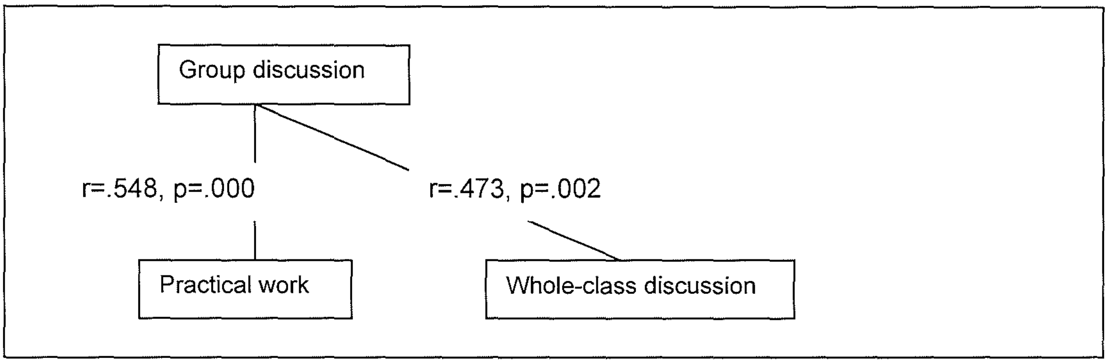


Figure 4.4.19: Correlations between teaching methods in terms of the frequency of the deployment: perceptions of 5th graders

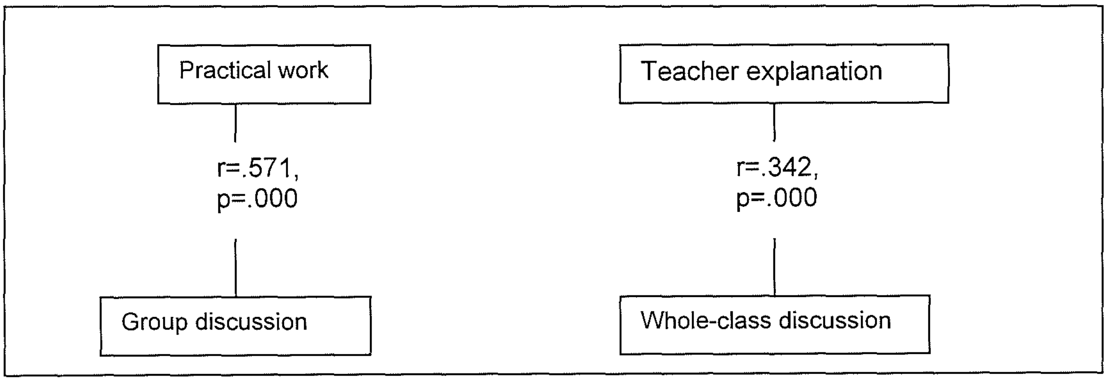


Figure 4.4.20: Correlations between teaching methods in terms of the frequency of the deployment: perceptions of 8th graders

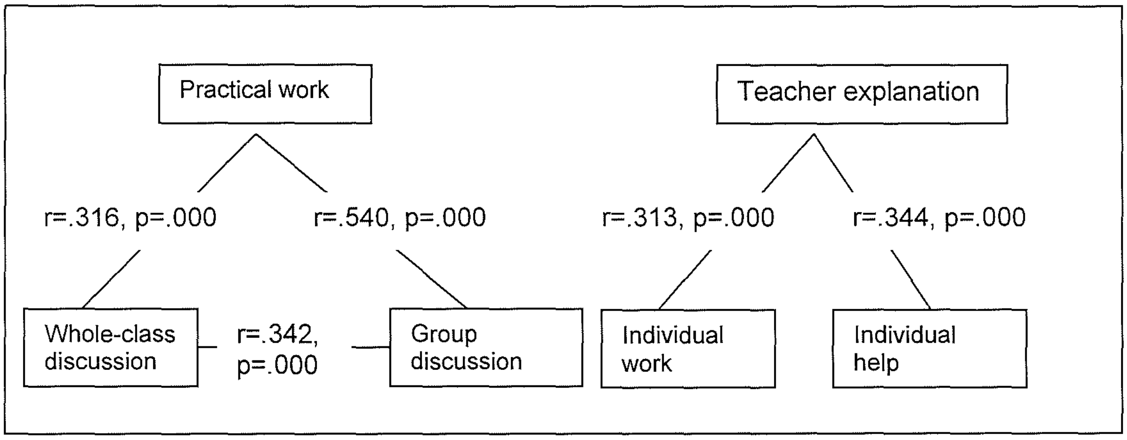


Figure 4.5.3 Relationships between attitudes to mathematics learning as promoted by *Practical work:* perceptions of 5th graders

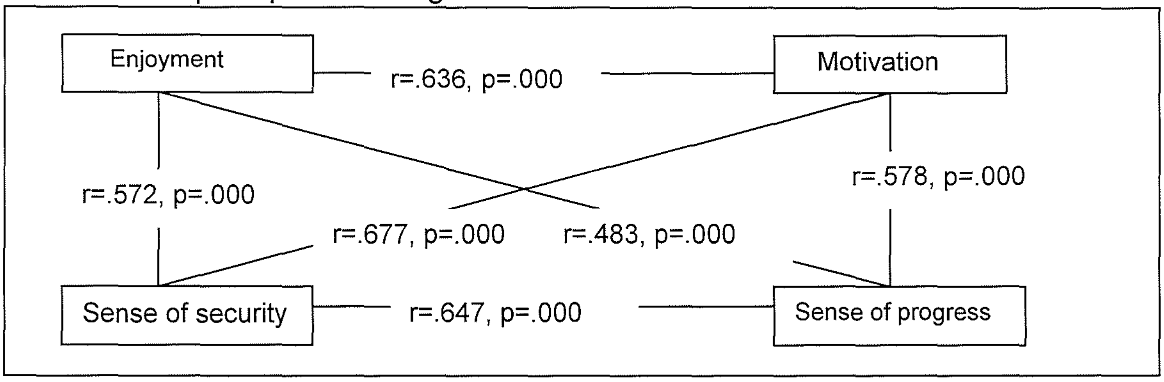


Figure 4.5.4 Relationships between attitudes to mathematics learning as promoted by *Practical work:* perceptions of 8th graders

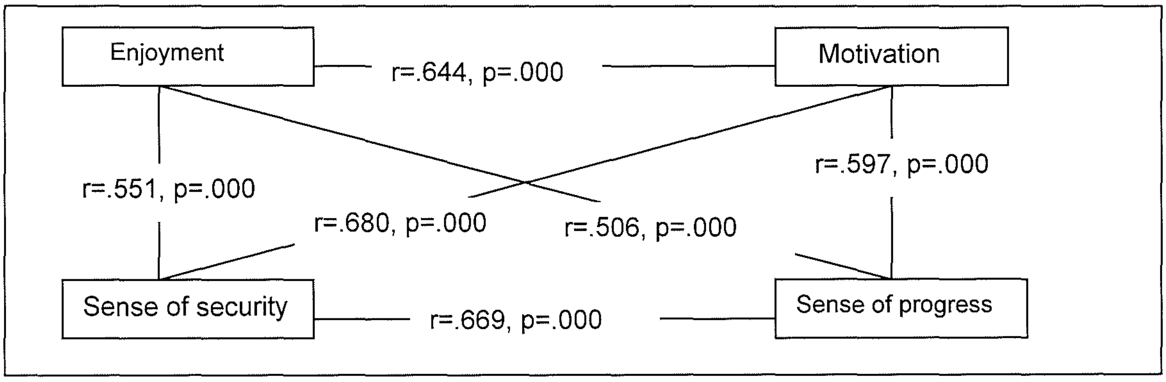


Figure 4.5.6: Relationships between attitudes to mathematics learning as promoted by *Using a computer.* perceptions of 8th grade teachers

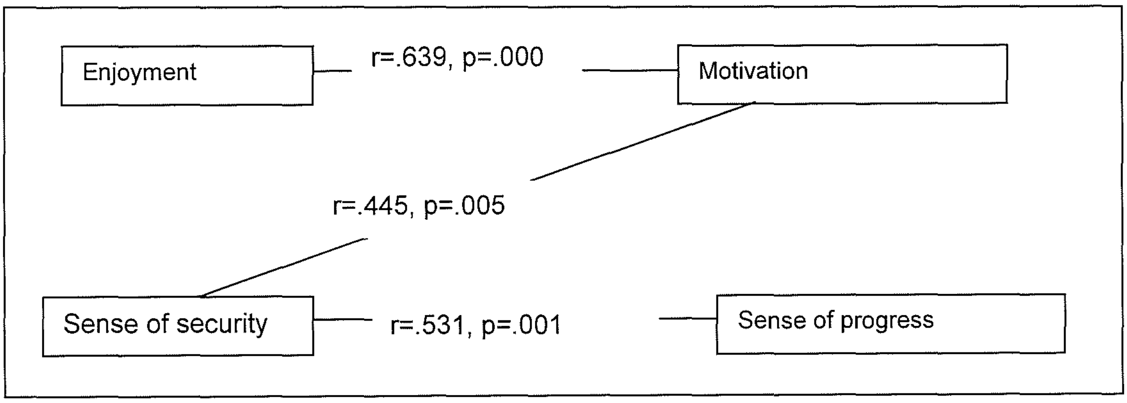


Figure 4.5.7: Relationships between attitudes to mathematics learning as promoted by *Using a computer*: perceptions of 5th graders

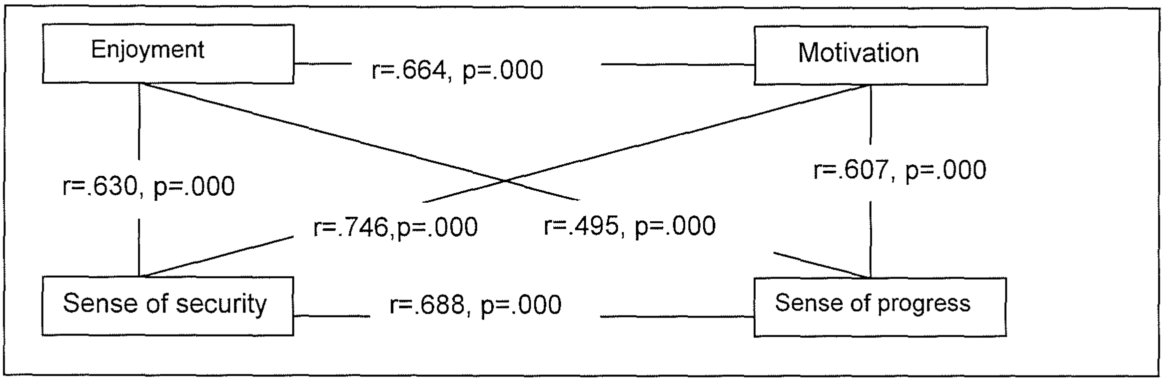


Figure 4.5.8: Relationships between attitudes to mathematics learning as promoted by *Using a computer*: perceptions of 8th graders

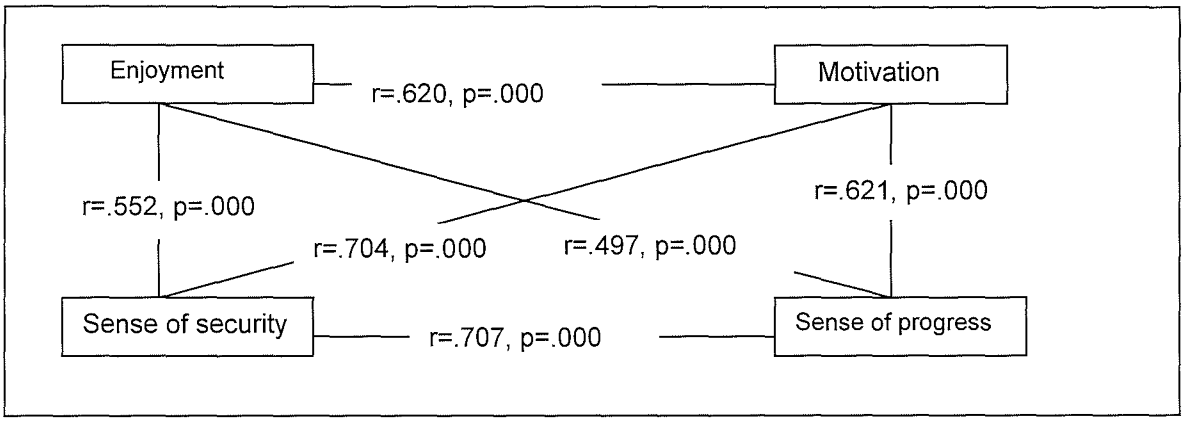


Figure 4.5.10: Relationships between attitudes to mathematics learning as promoted by *Reading a textbook*: perceptions of 8th grade teachers

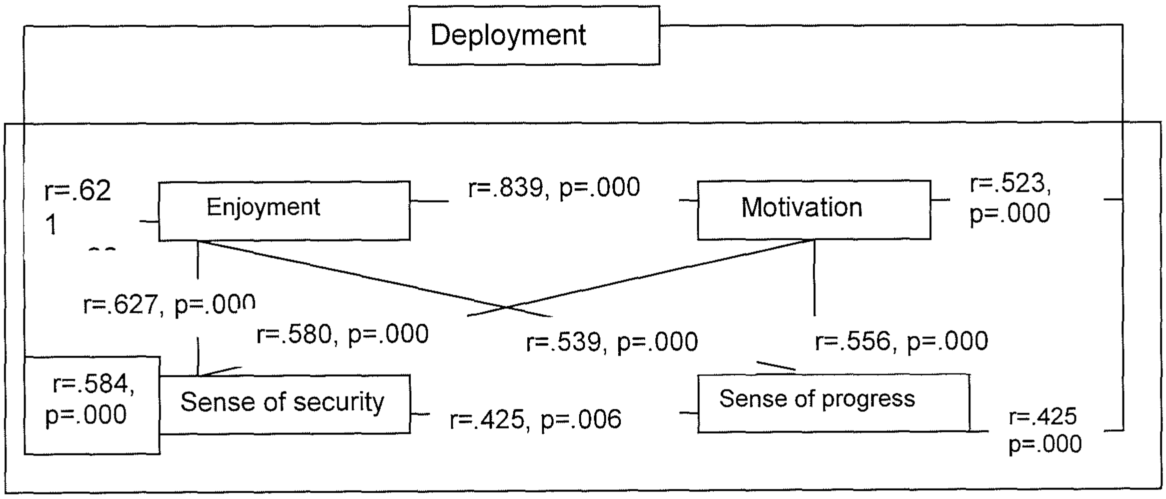


Figure 4.5.11: Relationships between attitudes to mathematics learning as promoted by *Reading a textbook*: perceptions of 5th graders

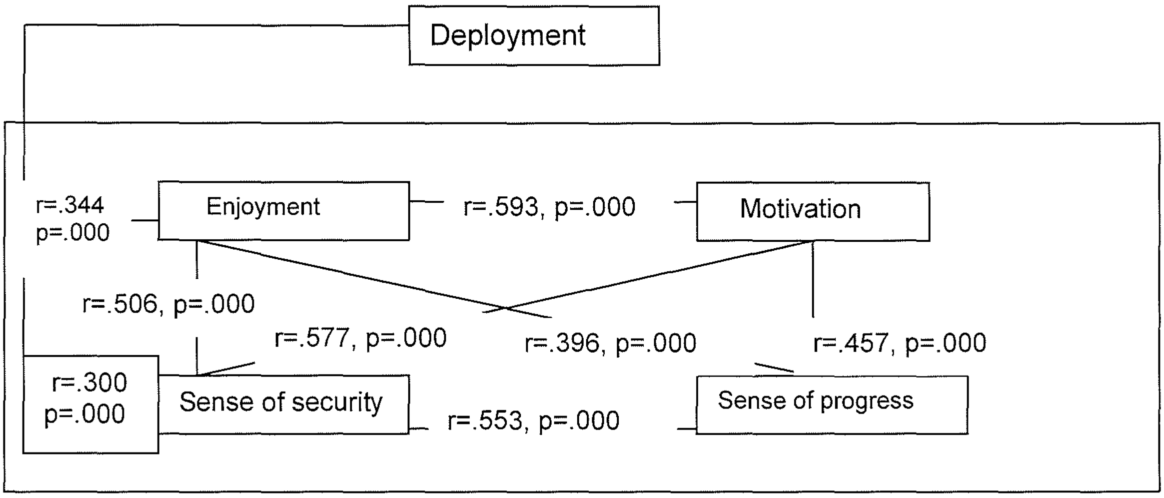


Figure 4.5.12: Relationships between attitudes to mathematics learning as promoted by *Reading a textbook*: perceptions of 8th graders

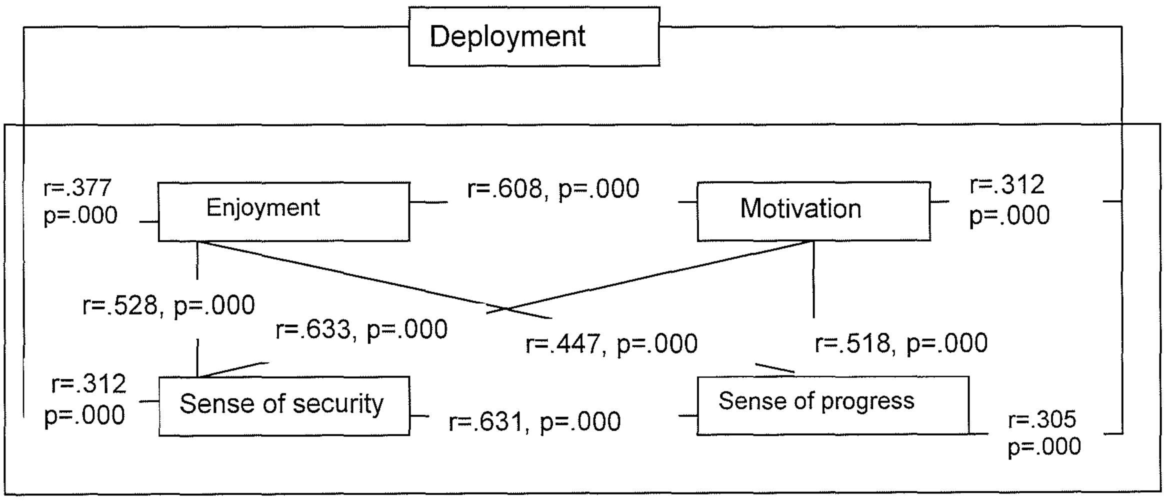


Figure 4.5.13: Relationships between attitudes to mathematics learning as promoted by *Teacher explanation*: perceptions of 5th grade teachers

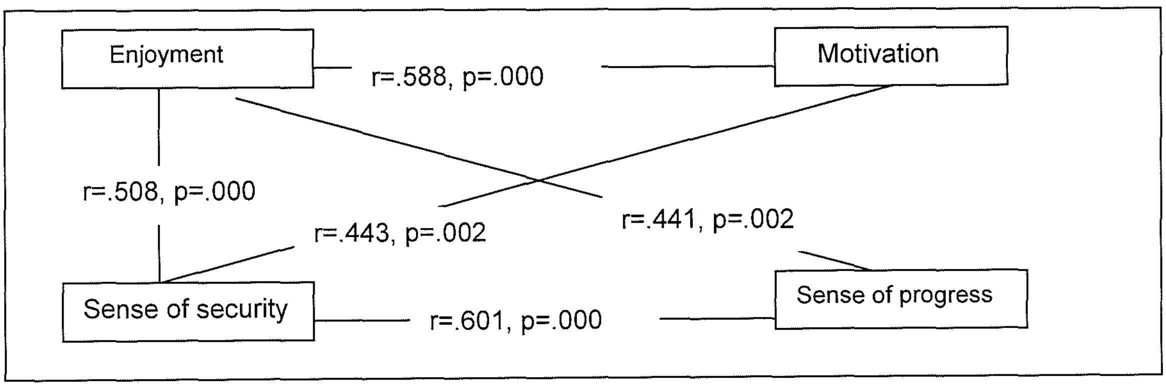


Figure 4.5.14: Relationships between attitudes to mathematics learning as promoted by *Teacher explanation*: perceptions of 8th grade teachers

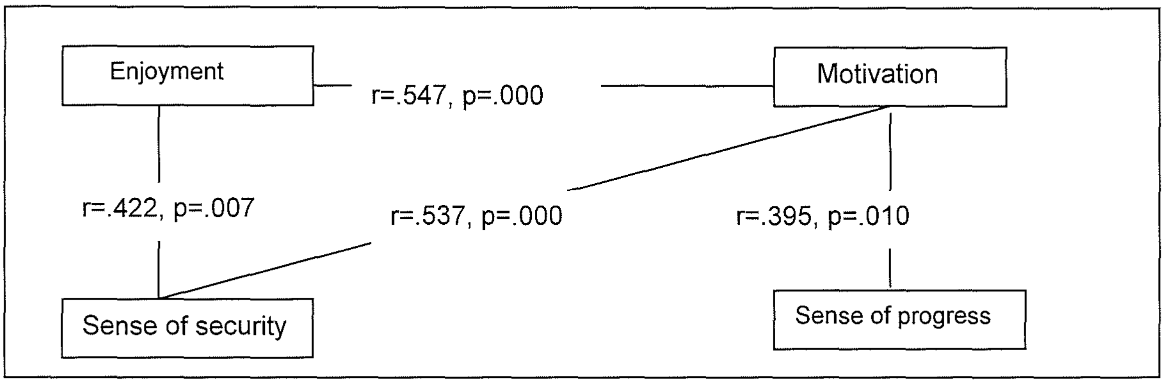


Figure 4.5.15: Relationships between attitudes to mathematics learning as promoted by *Teacher explanation*: perceptions of 5th graders

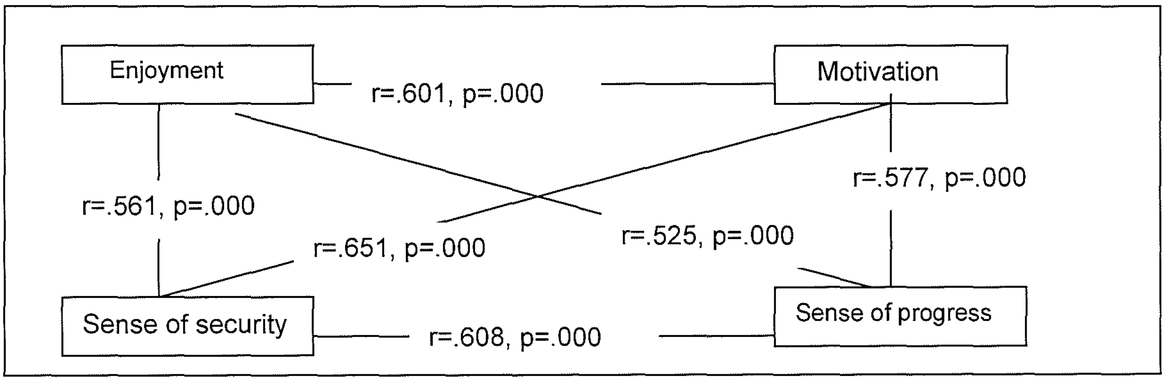


Figure 4.5.16: Relationships between attitudes to mathematics learning as promoted by *Teacher explanation*: perceptions of 8th graders

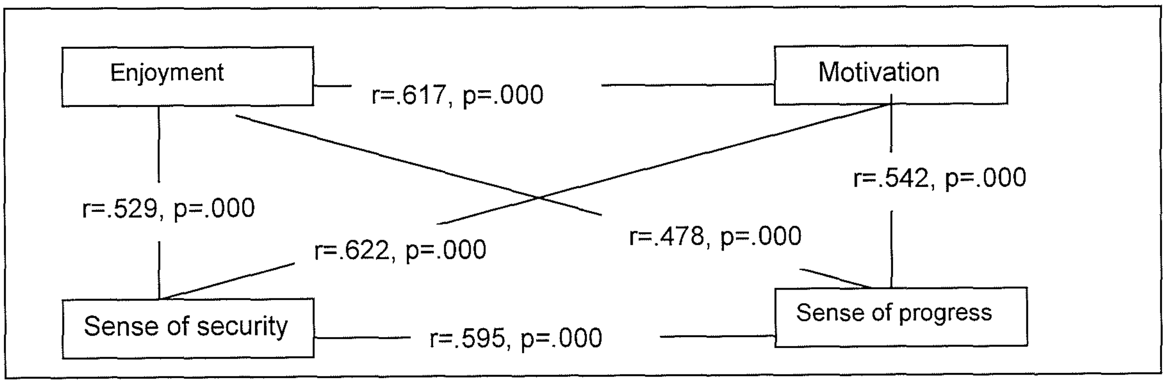


Figure 4.5.18: Relationships between attitudes to mathematics learning as promoted by *Individual work*: perceptions of 8th grade teachers

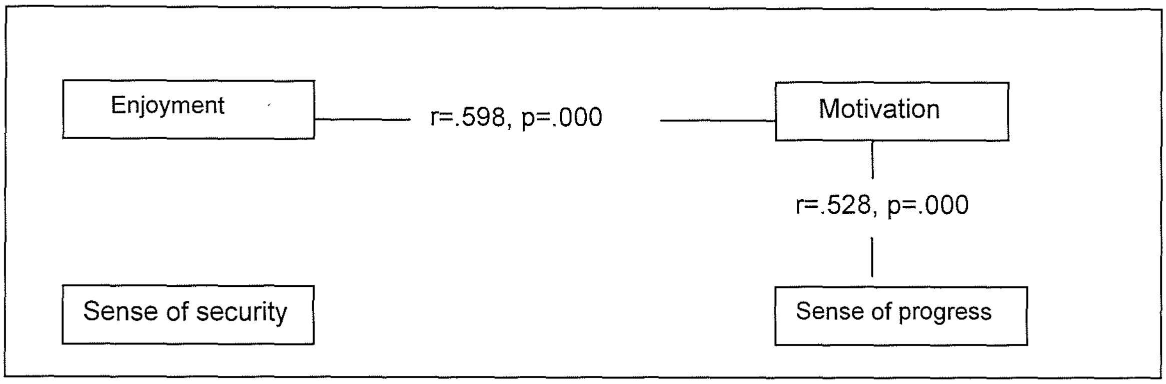


Figure 4.5.20: Relationships between attitudes to mathematics learning as promoted by *Individual work*: perceptions of 8th graders

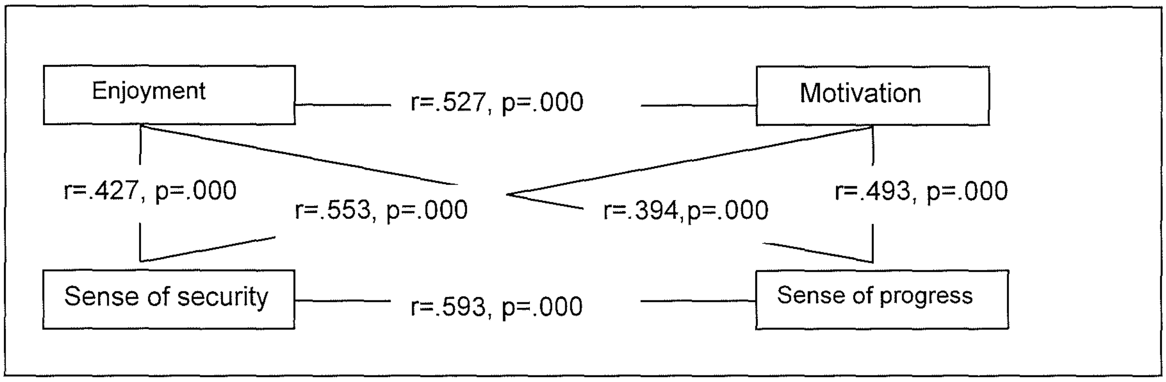


Figure 4.5.21: Relationships between attitudes to mathematics learning as promoted by *Individual help*: perceptions of 5th grade teachers

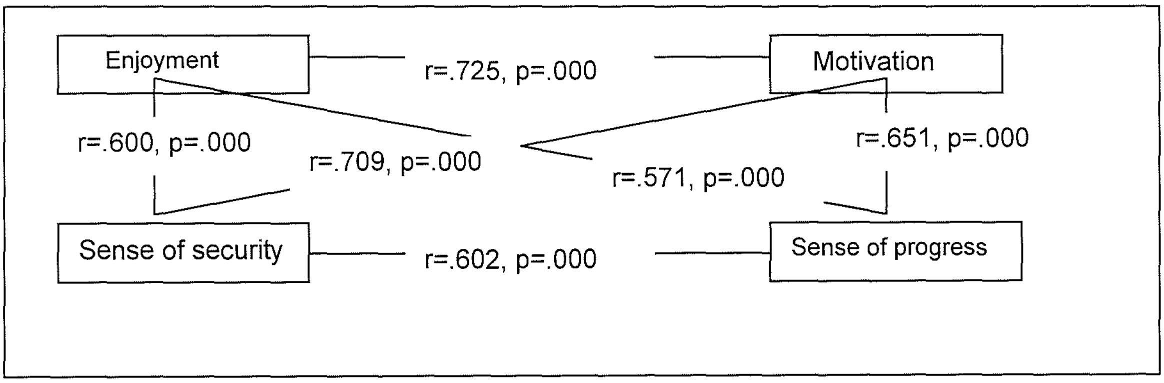


Figure 4.5.22: Relationships between attitudes to mathematics learning as promoted by *Individual help*: perceptions of 8th grade teachers

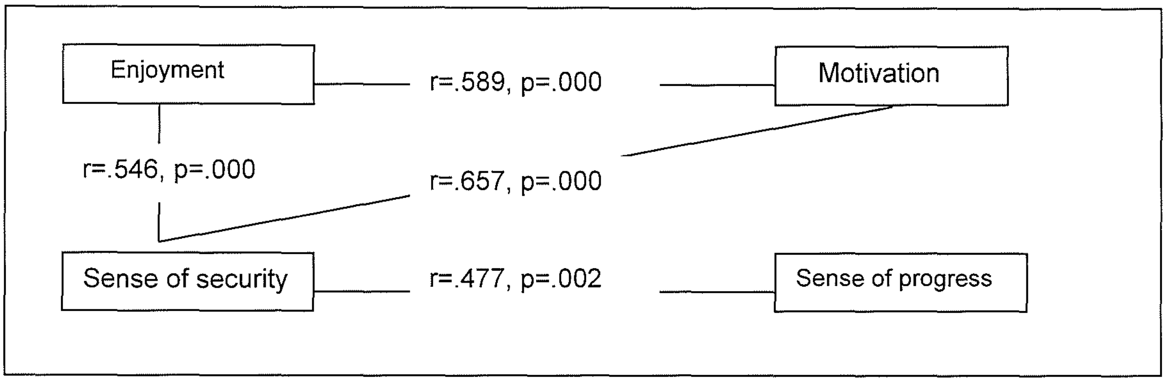


Figure 4.5.23: Relationships between attitudes to mathematics learning as promoted by *Individual help*: perceptions of 5th graders

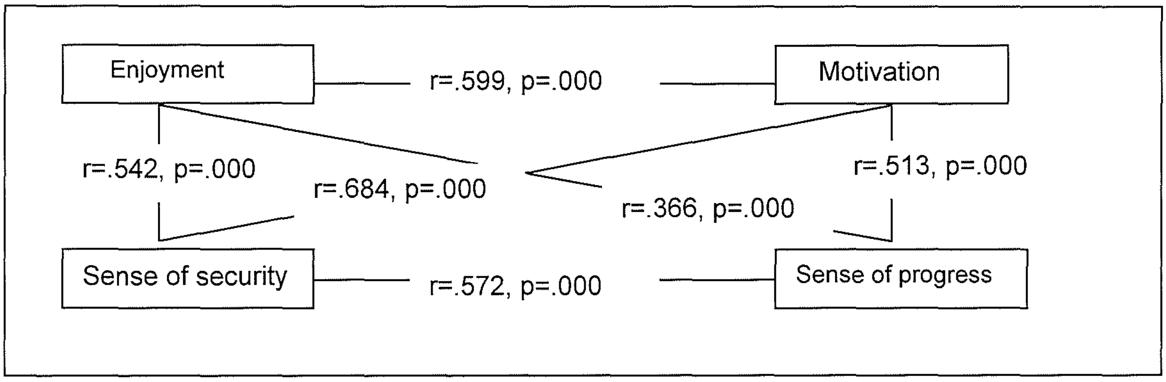


Figure 4.5.24: Relationships between attitudes to mathematics learning as promoted by *Individual help*: perceptions of 8th graders

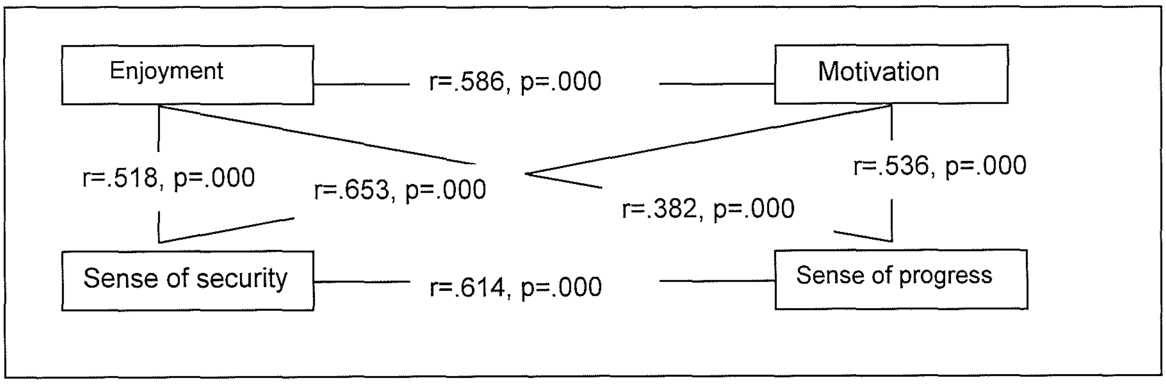


Figure 4.5.25: Relationships between attitudes to mathematics learning as promoted by *Whole-class discussion*: perceptions of 5th grade teachers

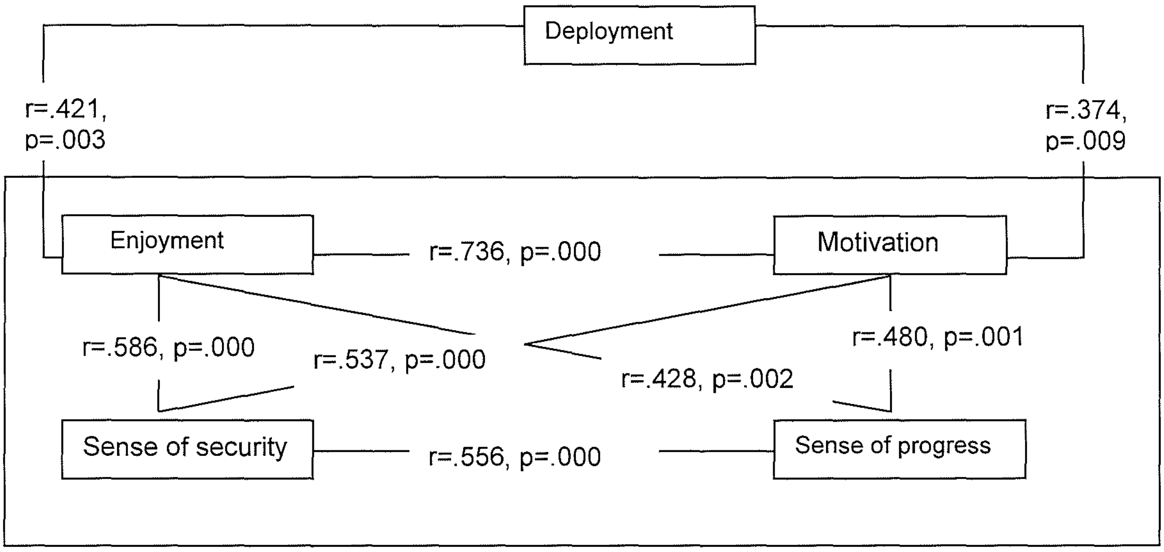


Figure 4.5.27: Relationships between attitudes to mathematics learning as promoted by *Whole-class discussion*: perceptions of 5th graders

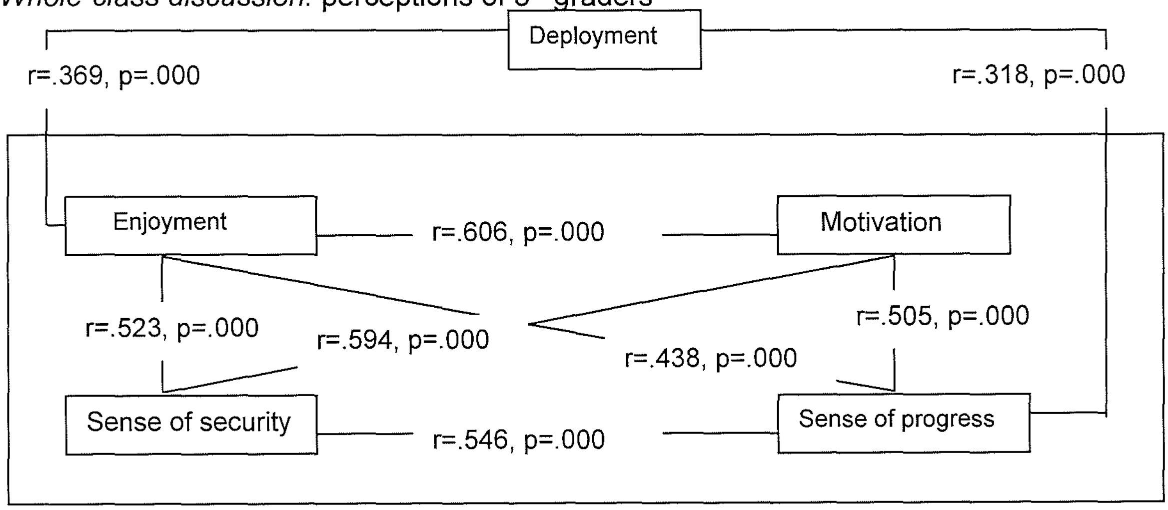


Figure 4.5.28: Relationships between attitudes to mathematics learning as promoted by *Whole-class discussion*: perceptions of 8th graders

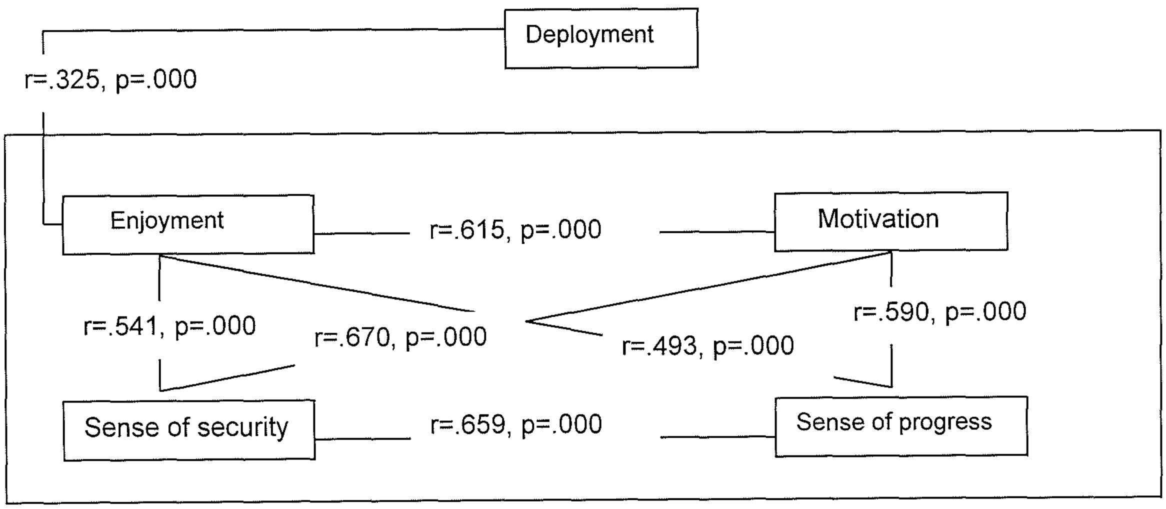


Figure 4.5.29: Relationships between attitudes to mathematics learning as promoted by *Group discussion*: perceptions of 5th grade teachers

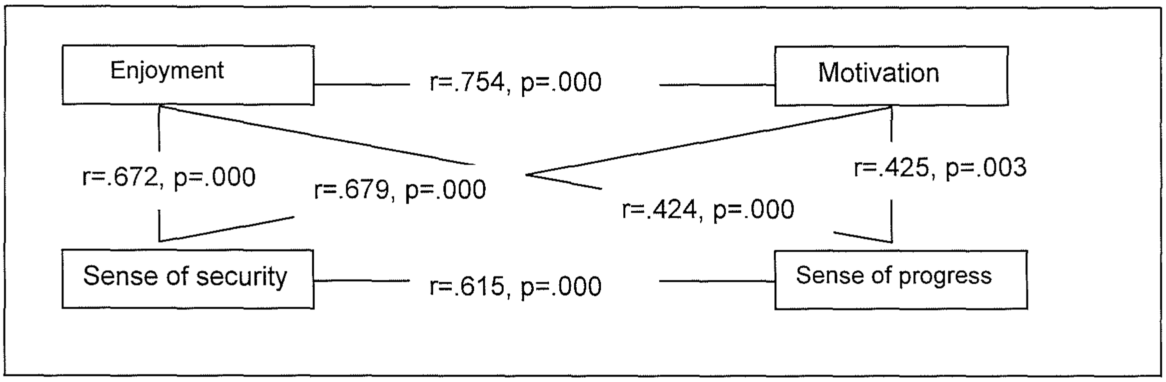


Figure 4.5.31: Relationships between attitudes to mathematics learning as promoted by *Group discussion*: perceptions of 5th graders

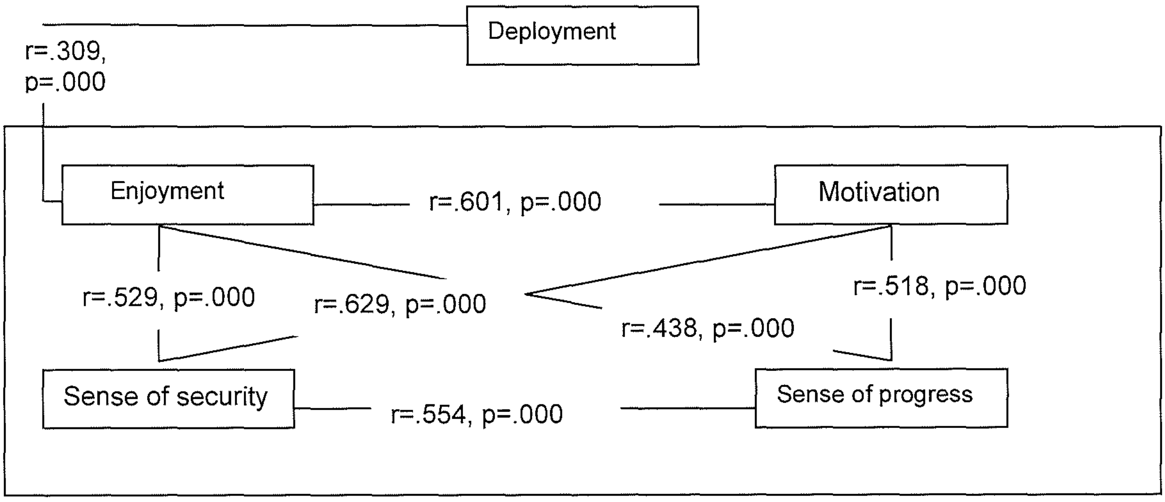
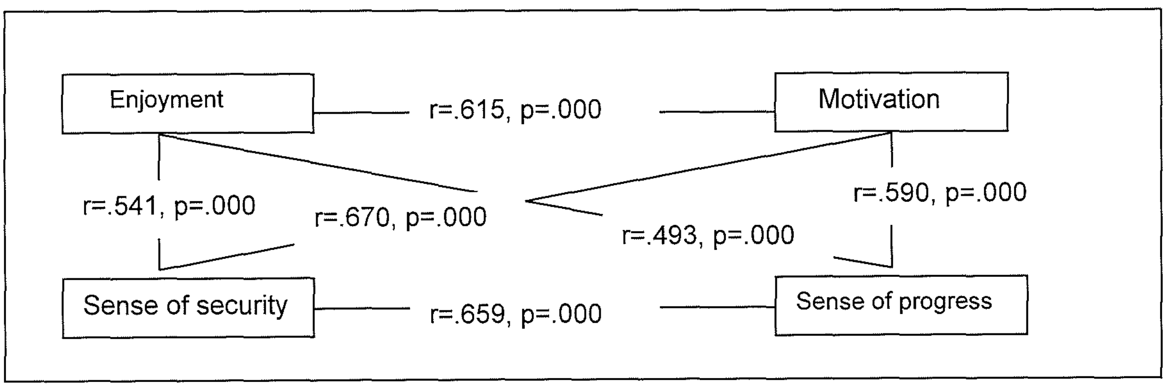


Figure 4.5.32: Relationships between attitudes to mathematics learning as promoted by *Group discussion*: perceptions of 8th graders



Chapter 5: citation from open questions of questionnaire survey (5^{th} T=5^{th} grade teachers; 8^{th} T=8^{th} grade teachers, 8^{th} p=8^{th} graders)

5.1.1	8^{th}	T	Pupils enjoy learning mathematics through doing something rather than learning passively.
5.1.2	5^{th}	T	Pupils enjoy taking part in some practical activities positively rather than only listening to my explanation passively.
5.1.3	5^{th}	T	Children enjoy learning mathematics autonomously.
5.1.4	5^{th}	T	This teaching method avoids teacher-led lessons.
5.1.5	8^{th}	T	Pupils enjoy practical work and experiments because these activities encourage them to learn mathematics autonomously.
5.1.6	8^{th}	T	Pupils enjoy discussion in a whole-class session, because it can make the lessons pupil-centred.
5.1.7	8^{th}	P	I enjoy learning mathematics because learning mathematics through some practical activities makes me feel it is easy to be involved.
5.1.8	8^{th}	P	I can understand, learn and think by myself. Being involved in such a process is enjoyable.
5.1.9	5^{th}	T	Children's interest in mathematics learning is promoted by adopting some computer program sessions in mathematics classes.
5.1.10	5^{th}	T	Practical work inspires pupils' curiosity towards what will happen in the end.
5.1.11	8^{th}	T	Pupils are interested in the lessons, which offer new experiences.
5.1.12	5^{th}	T	Pupils enjoy practical activities which involve game-like elements and are fun.
5.1.13	8^{th}	P	Observation and making something by hand in mathematics classes is more interesting for me than just doing exercises.
5.1.14	8^{th}	P	I am very interested in facing difficult problems.
5.1.15	8^{th}	P	Listening to teacher explanation is much more interesting than any other activities in mathematics classes.
5.1.16	8^{th}	P	I am curious about doing practical activities, because such activities are not often adopted in mathematics classes. I suppose it is different from learning mathematics through teacher explanation written on a blackboard.
5.1.17	8^{th}	P	I am using a computer at home, but I haven't come across any with mathematics programmes yet. I am very curious about programmes. They are something new and must be enjoyable.
5.1.18	8^{th}	P	We can enjoy learning mathematics just like a game with a computer.
5.1.19	8^{th}	P	We don't feel as if we are being forced to learn mathematics when we exercise with the computer programme.
5.1.20	8^{th}	P	I don't feel as if I'm doing mathematics when I am engaging in practical activities.
5.1.21	8^{th}	P	Children enjoy learning mathematics when they can learn mathematics in their own way and at their own pace.

5.1.22	8^{th}	P	Pupils enjoy learning mathematics when they learn mathematics according to their own level of attainment and preferred learning style.
5.1.23	5^{th}	T	Children of today like being supported individually by the teacher.
5.1.24	8^{th}	T	Pupils can get individual feedback regarding what they have learned, and support according to their needs.
5.1.25	5^{th}	T	Children feel valued by the teacher's individual support. Such feelings link to enjoyment in mathematics learning.
5.1.26	8^{th}	P	I can select exercises, which I need to practise more. I can avoid exercises, which I have already mastered.
5.1.27	8^{th}	P	I can proceed with my learning at my own pace. This is much more enjoyable than being left behind in whole-class session.
5.1.28	8^{th}	P	I enjoy learning mathematics through practical activities and discussion. I can learn mathematics according to my own interests.
5.1.29	8^{th}	T	Pupils enjoy learning mathematics through practical activities; because this teaching method promotes pupils' understanding better than learning mathematics through only internal thought.
5.1.30	8^{th}	T	Teachers can provide their pupils with clear explanations, which promote their pupils' understanding.
5.1.31	8^{th}	T	Providing repeated explanations patiently promotes pupils' understanding, as a result, pupils come to enjoy learning mathematics.
5.1.32	8^{th}	T	Pupils feel easy about asking questions of their peers and it promotes pupils' understanding.
5.1.33	8^{th}	P	Learning mathematics through practical activities is enjoyable because it is much easier to understand the curriculum through this method than thinking and writing in a notebook. We can learn mathematics through observation, listening and acting. We remember what we have learned much longer when we learn mathematics through these activities.
5.1.34	8^{th}	P	I enjoy learning 'shape' through computer graphics. We can see the shape and solid very clearly. It's easy to understand.
5.1.35	8^{th}	P	We can imagine what we are learning by reading explanations written in a textbook.
5.1.36	8^{th}	P	Our teacher explains the curriculum very clearly and I can understand her explanations very easily. I have come to feel that I am making progress and I enjoy learning mathematics.
5.1.37	8^{th}	P	I can increase my understanding of the curriculum through doing a lot of exercises. I can make progress in a trial and error manner through doing exercises. It is much more effective than talking the content through with classmates.
5.1.38	8^{th}	P	We can clarify what we have missed by receiving individual support from the teacher. We can make uncertain points clear on the spot and come to understand the content. Then, we come to enjoy learning mathematics.
5.1.39	8^{th}	P	Having a discussion in class deepens our understanding of the content. As our understanding is deepened, we come to enjoy learning mathematics more.
5.1.40	8^{th}	P	I feel it is easier to understand content when I learn mathematics with friends in a group. It is enjoyable to have such experiences.

5.1.41	5th	T	Pupils enjoy learning mathematics through practical work and experiential activities; because these opportunities activate the children's mathematics thinking.
5.1.42	5th	T	Children enjoy developing their mathematical concepts by sharing ideas in a class.
5.1.43	8th	T	Pupils enjoy sharing their views with peers and acquiring new perspectives.
5.1.44	8th	P	We can develop our concepts through observation rather than doing exercises. This is the reason why we enjoy observation.
5.1.45	8th	P	Knowing classmates' ideas through whole-class discussion is enjoyable. We can find various solutions by learning mathematics with many friends through whole-class discussion.
5.1.46	8th	P	Having discussion in the whole class makes me very confused, because too many people are involved. I think having discussion in a group is more beneficial to develop mathematical concepts. I can put forward my own views then.
5.1.47	8th	P	We can communicate with classmates in sharing ideas in mathematics classes.
5.1.48	8th	P	Learning mathematics in a group is enjoyable, because we can make friends while learning mathematics. We can increase the trust between us.
5.1.49	8th	P	I enjoy learning mathematics with friends. I feel lonely when I am studying alone.
5.1.50	8th	P	Pupils enjoy learning mathematics with peers. They also enjoy being involved positively in some practical activities.
5.1.51	8th	P	I enjoy mathematics learning when my teacher helps me. I can enjoy learning mathematics when I talk some problems to my teacher.
5.1.52	8th	P	I enjoy individual learning sessions, because I can concentrate on my work.
5.1.53	8th	P	My teacher tells us clearly which page of the workbook to use. It is enjoyable to do a few exercises every day.
5.1.54	8th	P	I like listening to explanations from my teacher and doing exercises in the workbook, because I am accustomed to these learning styles.
5.1.55	8th	P	I enjoy learning mathematics when I can see myself completing the task faster than others.
5.1.56	5th	T	Both whole-class sessions and individual attention are necessary to promote the pupils' enjoyment in mathematics learning. The former teaching method can develop their mathematics concepts with peers, while the latter teaching method promotes the individual's understanding.
5.1.57	8th	T	Pupils can share various ideas through group discussion. Practical work promotes pupils' understanding in a tangible way. Using a computer promotes pupils' understanding through the visual sense. Together, they come to enjoy learning mathematics.
5.1.58	5th	T	Adoption of practical work and group discussion in combination is important to promote pupils' enjoyment in mathematics learning. Practical work allows pupils to feel relaxed as they take part, irrespective of their capabilities, while group discussion is a good opportunity to develop the pupils' understanding through learning from peers.

5.1.59	5^{th}	T	Pupils enjoy practical activities because this teaching method allows the pupils' autonomy in learning and promotes their understanding of the curriculum.
5.1.60	8^{th}	T	The teaching methods which promote pupils' interest and understanding of the curriculum together, promote pupils' enjoyment in mathematics learning.
5.2.1	5^{th}	T	Pupils are motivated to learn mathematics when they feel accomplishment and satisfaction through autonomous learning.
5.2.2	8^{th}	T	This teaching method avoids providing pupils with a sense of being forced to learn. On the contrary, pupils feel motivated to learn mathematics autonomously.
5.2.3	8^{th}	P	I am motivated to find the answer through practical work with trial and error. I easily become involved in this activity.
5.2.4	8^{th}	P	I try harder to learn mathematics in individual sessions rather than whole-class sessions because I have to rely on myself in individual sessions.
5.2.5	5^{th}	T	Children are motivated to learn mathematics by being involved in practical work. I think that the lack of experience of making or doing something from their younger days inspires their curiosity towards learning mathematics by this method.
5.2.6	8^{th}	T	Pupils are more interested in observation and experiences than thinking at the desk. Practical work can avoid providing pupils with repeated practice. It maintains pupils' motivation to learn mathematics.
5.2.7	8^{th}	P	The teaching methods which inspire our interest promote our motivation to learn mathematics.
5.2.8	8^{th}	P	I feel I try hard when I take part in practical activities, because I am very interested in what we can find out through experiments.
5.2.9	8^{th}	P	I am motivated to learn mathematics by using a computer, because learning mathematics by using a computer is more interesting than learning mathematics from just listening to teachers' explanations.
5.2.10	8^{th}	P	Mathematics is my favourite subject, and I can do it well. I am interested in doing exercises and am motivated to do them.
5.2.11	8^{th}	P	I will be motivated to learn mathematics by using a computer, because lessons using a computer must be different from the ordinary lessons.
5.2.12	8^{th}	T	It is important to value individual needs rather than collective needs. In a whole class, it is important in order to promote pupils' motivation to learn mathematics.
5.2.13	5^{th}	T	This teaching method can maintain pupils' motivation to learn mathematics, because it can avoid uniform style lessons.
5.2.14	5^{th}	T	Pupils' attainments become more diverse as their grades proceed. The teaching methods which cater for the pupils' individual needs promote their motivation to learn mathematics.
5.2.15	8^{th}	T	Teachers can provide support to individuals according to their level of understanding so pupils are motivated to apply their understanding to other tasks.
5.2.16	5^{th}	T	Pupils can proceed in their mathematics learning in their own way; this affects pupils' motivation positively.

5.2.17	5^{th}	T	Children can learn mathematics according to their interest when they learn mathematics through practical activities, as a result, their motivation is promoted.
5.2.18	8^{th}	P	I am motivated to learn mathematics in individual work. I can do exercises at my pace and repeat questions I am uncertain about until I am sure I can do them.
5.2.19	5^{th}	T	Children are motivated to learn mathematics when they understand what they are learning and feel able to manage the task provided.
5.2.20	8^{th}	T	Pupils are motivated to learn mathematics when they get satisfaction from being able to understand the learning content.
5.2.21	5^{th}	T	Children are motivated to learn mathematics through interaction with peers because such interaction promotes their understanding of the curriculum.
5.2.22	5^{th}	T	Learning mathematics with tangible things will promote children's understanding in a concrete way, as a result, they are motivated to learn mathematics.
5.2.23	8^{th}	T	Individual help is beneficial in promoting pupils' motivation to learn mathematics, because it clarifies what pupils have previously missed.
5.2.24	8^{th}	P	I come to understand the content by doing exercises. As I feel able to understand the content, I feel happier. Then, I come to try harder to learn mathematics.
5.2.25	8^{th}	P	I came to understand mathematics with my teachers' help in individual sessions. Then, I gradually felt able to try hard to deal with the tasks.
5.2.26	8^{th}	P	I try hard to learn mathematics with my peers, because listening to their explanation promotes my understanding of the content.
5.2.27	8^{th}	P	I try to read the explanation written in a textbook repeatedly when I am uncertain about particular points. As I gradually come to understand the content, I feel able to try hard to learn mathematics.
5.2.28	5^{th}	T	Knowing others' views and examining their justifications and the suitability of each solution motivates pupils to learn mathematics.
5.2.29	8^{th}	T	Practical activities promote pupils' motivation to learn mathematics, because this teaching method develops their mathematical concepts through trial and error.
5.2.30	8^{th}	T	Pupils are motivated to learn mathematics by using a computer. Computers can develop their mathematical concepts through the visual sense.
5.2.31	8^{th}	P	I feel able to try harder to learn mathematics when I know other students' views.
5.2.32	8^{th}	P	We can teach each other in a group. It is enjoyable and I am motivated to try hard.
5.2.33	8^{th}	P	I am motivated to learn mathematics when I see everyone around me trying.
5.2.34	8^{th}	P	I am motivated to learn mathematics when I undertake tasks with my friends or classmates who have similar mathematics marks.
5.2.35	8^{th}	P	I may give up difficult problems when I am doing them by myself. But I feel able to try hard to do them when my teacher helps me.
5.2.36	8^{th}	P	I feel able to try harder when I get praise from my teacher irrespective of whether it is in an individual session or a whole-class session.

5.2.37	8th	P	I cannot concentrate on the lessons in whole-class sessions with many other students. But I can concentrate on the tasks in individual sessions. So, I'm very motivated to learn mathematics in individual sessions.
5.2.38	8th	P	I feel disturbed when I learn mathematics in a group. I don't feel anyone disturbing me in an individual session, and I can concentrate on doing the task. So, I'm more motivated to learn mathematics in an individual session than a group session.
5.2.39	8th	P	I am motivated to raise my views in class discussion, because it involves some competition with peers.
5.2.40	8th	P	I am motivated to learn mathematics in a group session. I really wish to keep up with the students who have higher marks than me.
5.2.41	5th	T	Practical work promotes pupils' motivation to learn mathematics, because this teaching method inspires pupils' interest, while it promotes their understanding of the curriculum.
5.2.42	5th	T	I think adopting both practical work and individual help will help pupils to be motivated to learn mathematics. Practical work and experiments promote pupils' interest in learning mathematics, while providing individual help promotes their understanding.
5.3.1	5th	T	Pupils will feel secure if teachers can provide their pupils with support according to their individual current attainment.
5.3.2	8th	T	Individual learning after a certain period of whole-class explanation is important to maintain the individual's sense of security. Each child can receive support about what they have missed so far.
5.3.3	5th	T	Some pupils can be involved in discussion positively through putting forward their views. Others can be involved by just listening. So, pupils be either active or passive according to their preference. So, pupils feel secure in learning mathematics through discussion.
5.3.4	5th	T	Pupils feel secure in dealing with tasks at their own pace.
5.3.5	8th	T	Pupils can proceed in learning at their own pace, so they can feel secure in learning mathematics.
5.3.6	5th	T	Pupils can learn mathematics according to their own interest, so they feel secure in mathematics learning.
5.3.7	8th	P	I feel secure in individual sessions; because I don't need to be nervous about being left behind others when I learn individually.
5.3.8	8th	P	I can take time to understand the problem when I learn individually. This is why I feel secure in learning mathematics in individual sessions.
5.3.9	5th	T	Pupils can feel secure in learning mathematics by getting individual support though interaction with the teacher or peers.
5.3.10	5th	T	Pupils of today feel secure in learning mathematics individually because they are not good at interaction with others.
5.3.11	8th	T	This teaching method prevents pupils from making mistakes in public, so pupils feel secure in learning mathematics.
5.3.12	8th	T	This teaching method can prevent pupils from feeling they are compared in their performance with peers, as a result, pupils' feeling secure is ensured.
5.3.13	8th	P	I don't like either being observed by others or raising my views in a class. So, I feel secure in individual sessions. I try to solve the problems by myself and to get help from the teacher when I need it.

5.3.14	8th	P	I can't be calm in a class if I feel observed by many people. I am quite OK in a group session with a few members.
5.3.15	8th	P	I can reduce my anxiety when I learn with my peers in a group. I feel much easier asking my friends uncertain points than the teacher. When I find other group members have uncertain points, I can avoid the feeling of only me being left behind.
5.3.16	8th	P	I sometimes feel nervous when I work on tasks by myself. But I feel secure when I remember that my teacher helps me when I need her help.
5.3.17	8th	P	I don't need to be too anxious in my mathematics classes, because I know my teacher is paying attention to every student.
5.3.18	5th	T	Practical work can promote pupils' sense of security, because pupils' understanding is more smoothly promoted by contact with concrete objects rather than abstract thinking.
5.3.19	5th	T	I think that pupils feel more secure when they learn mathematics with peers in a group. This is because their understanding is promoted by discussing what they have not understood and supporting each other with peers.
5.3.20	8th	T	Pupils feel more secure in learning mathematics through listening to explanations from the teacher. Teachers can explain accurately what the pupils have not mastered; as a result, pupils' understanding is promoted.
5.3.21	8th	T	Once pupils know that they can get over the problem, they feel secure in accepting the challenge of new problems. Thus, individual help from teacher will be beneficial in helping pupils feel secure in mathematics learning.
5.3.22	8th	P	I come to reduce my anxiety in learning mathematics when I find myself being able to manage the task. I think it is important to overcome the difficulties with help from the teacher.
5.3.23	8th	P	I feel secure when I am becoming familiar with what I should do in the next step and I find the solution as others do. My teacher can explain very clearly, so we can understand his explanation quite easily.
5.3.24	5th	T	Pupils feel secure in learning mathematics once they start to think and develop their mathematics concepts. Experiential learning is beneficial to develop pupils' mathematical concepts, because such experiences encourage them to start thinking.
5.3.25	8th	T	Pupils feel secure in learning mathematics through having discussion with peers, because sharing perspectives with peers can widen the pupils' mathematical concepts.
5.3.26	8th	P	Listening to others' perspectives makes me feel secure.
5.3.27	8th	P	I feel secure in learning mathematics in a group; because I feel much more confident about raising my views when I learn mathematics in a group than in a whole class.
5.3.28	8th	P	Knowing various views from a lot of members of the class and feeling sympathy with those who have the same view as mine gives me confidence. As a result, I can feel secure in mathematics learning.
5.3.29	5th	T	Pupils feel secure in doing practical work, because pupils can take part in the activities, irrespective of their current attainment.
5.3.30	5th	T	Pupils feel secure when they feel involved in mathematics classes through putting forward their views in mathematics classes.

5.3.31	5th	T	Pupils feel secure when they feel able to deal with mathematics learning autonomously, not passively.
5.3.32	8th	T	Pupils feel secure when they feel involved in mathematics classes through putting forward their views.
5.3.33	8th	P	Doing work alone makes me feel secure, rather than relying on others.
5.3.34	8th	T	Pupils are interested in challenging new things. This is also the case in learning mathematics. It promotes their sense of security.
5.3.35	8th	P	I feel secure in learning mathematics through using a computer, because it is fun and I can learn mathematics with a game-like feeling.
5.3.36	8th	P	I feel secure in learning mathematics with this method, because it is something new.
5.3.37	8th	P	I sometimes get nervous when I listen to my teacher's explanation. But I can calm down and feel secure in doing tasks by myself.
5.3.38	8th	P	I feel secure in individual sessions, because I can concentrate on my tasks. I feel very confused when I learn mathematics in a group.
5.3.39	8th	P	I feel secure in learning mathematics with the methods which I am accustomed to, such as listening to teacher explanation and doing exercises.
5.3.40	8th	P	I feel secure in learning mathematics with these methods, because I have managed to do well using these methods so far.
5.3.41	5th	T	Practical work can promote pupils' interest and autonomy in learning on the one hand, and their understanding on the other hand. This method also can develop pupils' mathematical concepts at an individual pace. As a result, their sense of security is ensured.
5.3.42	5th	T	Adopting discussions and individualised teaching methods in combination is beneficial to promote pupils' sense of security in mathematics classes. Discussions encourage pupils to develop their mathematical concepts through sharing ideas with peers, while individualised methods meet individual needs to resolve the points of uncertainty by themselves or with help from the teacher. In addition, the individual child can bring the findings gained through individualised methods to discussion with peers.
5.3.43	8th	P	I can deepen my understanding of the curriculum through doing exercises individually. Afterwards, I can ask my teacher about unclear points. I can reduce anxiety when I learn mathematics this way.
5.4.1	5th	T	Pupils can have a sense of progress in individual sessions, because individuals can deal with the tasks according to their current attainments and get support from the teacher to satisfy their needs. Then, they have a sense of accomplishment and progress.
5.4.2	8th	T	Wide individual differences exist in pupils' current attainment in the classroom. Therefore, preparing tasks matched to individual attainment and supporting pupils individually encourages them to have a sense of progress.
5.4.3	8th	P	I can learn mathematics at my own pace in individual sessions, so I can have a sense of progress in individual sessions.
5.4.4	8th	P	I feel progress when I learn mathematics individually, because I can pick out the problems, for which I need to be trained, and focus on practising similar problems until I get feeling of progress.

5.4.5	8^{th}	T	Practical work promotes pupils' sense of progress, because learning mathematics through experience rather than merely cramming knowledge promotes pupils' understanding.
5.4.6	5^{th}	T	Teacher explanation is the central method to promote pupils' understanding of content, and this method ensures pupils' sense of progress, because teachers can explain accurately what the pupils have not mastered.
5.4.7	5^{th}	T	Although learning mathematics through experience promotes pupils' understanding of the curriculum, pupils need to be taught knowledge to support their experiences and to promote their understanding. A combination of practical activities and accurate explanation from the teacher will be the most effective measure to promote pupils' understanding of the curriculum and sense of progress.
5.4.8	8^{th}	P	I sense my progress when I come to understand the learning content. I think it is important to do exercises after listening to the explanation of the teacher carefully.
5.4.9	8^{th}	P	Understanding of the learning content is important for having a sense of progress in mathematics lessons. I think listening to the teacher's explanation and reading an explanation written in a textbook repeatedly is important to promote understanding.
5.4.10	8^{th}	T	Discussion-style teaching methods encourage pupils to raise their views positively in mathematics classes and promote their sense of progress.
5.4.11	8^{th}	P	I believe that the accumulation of individual effort is important to have a sense of progress in mathematics learning.
5.4.12	8^{th}	P	I think cultivating individual competencies by individual effort is important to promote a sense of progress.
5.4.13	5^{th}	T	Discussion provides pupils with the opportunity to know others' ideas and compare them with their own ideas, as a result, they come to have a sense of progress.
5.4.14	8^{th}	P	We can find different perspectives through having discussion and developing our concepts. I feel progress when I come to develop abstract concepts.
5.4.15	8^{th}	P	I feel progress when I can put forward my views. I have more opportunities to put forward my views when I study individually or in a group than in the whole class. So, I think that individual or group learning is more effective in promoting our sense of progress than whole-class sessions.
5.4.16	8^{th}	P	I think I can promote my sense of progress by this method, because this method is something new and different from traditional methods.
5.4.17	8^{th}	P	I feel easy about asking my friends when I am uncertain. So, learning with friends is effective in having a sense of progress.
5.4.18	8^{th}	P	I feel guilty if I do not try hard to learn mathematics when my teacher helps me individually. The teacher's help encourages me to learn mathematics thoroughly and, as a result, I come to feel progress.
5.4.19	8^{th}	P	I think learning mathematics individually or in a small group is much more effective in giving a sense of progress in mathematics classes, because we can concentrate on the task provided.

5.4.20	8th	P	I have felt progress so far. Therefore, learning mathematics with the teaching methods deployed in mathematics classes at present is effective to promote my sense of progress.
5.4.21	8th	T	Individualised learning methods provide pupils with support according to the individual's current needs, promote the pupils' understanding of the content, and in turn, promote the pupils' sense of progress.
5.4.22	5th	T	Both practical work and discussion should be adopted to promote the pupils' sense of progress. Learning mathematics through experience will promote the pupils' understanding of the learning content, while sharing views with peers will develop their mathematical ideas.
5.4.23	8th	P	I think I can feel progress through receiving help from the teacher in individual sessions. I can ask her repeatedly about areas where I am uncertain, and actually, I feel I am improving my understanding.

Chapter 6: citation from open questions of questionnaire survey (5^{th} =5^{th} grade teachers; 8^{th} =8^{th} grade teachers)

6.1.1	5^{th}	I am setting up ensuring that my pupils enjoy learning as one of the most important aims in my mathematics classes. It is well known that many pupils dislike mathematics, even though they can do well. I think it is possible to put on the brake against such pupils' disaffection towards mathematics learning if we find a way, for pupils to enjoy learning mathematics.
6.1.2	5^{th}	Pupils' motivation seems to be promoted when they think learning mathematics is enjoyable. On the other hand, if the lesson is boring and pupils feel bored, how can they be motivated to learn mathematics? I want my pupils to feel that learning mathematics is enjoyable. This is the starting point of promoting their motivation to study.
6.1.3	8^{th}	I think ensuring that my pupils enjoy learning mathematics is very important. If they feel bored when learning mathematics, they may lose their motivation to learn mathematics. I am working at a girls' junior high school. If they know learning mathematics is enjoyable, as I wish, many girls may be motivated to continue studying mathematics in higher education. Therefore, it is important how far they can experience enjoyment in mathematics learning during the days when they learn mathematics as compulsory. Teachers have responsibility in this sense.
6.1.4	5^{th}	I think it is only until around 3^{rd} grade that we can focus on the promotion of pupils' enjoyment in mathematics classes. We can ensure that younger children become fond of learning mathematics through enjoyable lessons. If they are fond of learning mathematics, they will be motivated to learn it. So, enjoyment in classes is important for them. But, I think pupils already have stable feelings favouring mathematics or not, by 5^{th} grade. It seems too late to make them enjoy learning mathematics and make them come to favour it. Therefore, it is much more important to encourage pupils to have confidence, although I do not mean that enjoyment in learning mathematics is useless. I would rather like to them to have a belief that everyone can master the content as well as other classmates if they try hard.
6.1.5	5^{th}	I think that children keep what they have learned in long-term memory when they learn something through inspiration rather than memorisation. Therefore, it is desirable for the children to master the curriculum through enjoyable activities. But, in reality, I have to complete the curriculum content in a limited number of classes. Covering all the content written in the textbook is quite tough, actually.
6.1.6	5^{th}	It would be nice to make pupils enjoy learning mathematics and improve their mathematics attainments, at the same time. Parents are greatly concerned about their children's attainments. I have a lot of opportunities to listen to parents. Although parents worry about children's adaptation at school, for instance, peer relationships, their greatest concern is about children's attainment, especially in literature and mathematics. Parents believe that improvement of children's mathematics attainments at elementary school is very important as the foundation for children's academic career in the future. Because of this, I need to put priority on improvement of pupils' mathematical attainment.

6.1.7	8th	As you know, mathematics is, in almost all cases, required at the entrance examination for senior high school. So, we have to focus on improving pupils' attainments up to a certain level, even though they do not appear to enjoy doing the tasks. Especially, this is getting much more important after the latter stage of the 2nd year. I sometimes feel tension between an ideal education, which considers the pupils' positive feelings about learning mathematics, and the actual situation, which requires cramming knowledge and skills to get through the entrance examination.
6.1.8	8th	It is very important for me to ensure that my pupils enjoy learning mathematics. However, not all of the children are interested in the same topic or the same materials. So, I don't think I can make all of the children in my class enjoy learning mathematics all the time.
6.1.9	5th	Pupils can concentrate on their tasks when they are enjoying lessons, while they start whispering if they feel bored with the lessons.
6.1.10	8th	When pupils feel bored with lessons, they do not reply to my questions and lose their concentration on the tasks. On the other hand, I can see in the pupils' eyes when the lesson is enjoyable.
6.1.11	5th	It is sometimes very difficult to assess the pupils' feelings in mathematics classes from their behaviour or facial expression. I know some children are enjoying doing exercises even though they seem to be doing so glumly. Others, who are not willing to raise their hands, sometimes are highly interested in learning mathematics. In contrast, some children who raise their views very frequently do not necessarily enjoy learning. I have many opportunities to observe other teachers' classes, just as I open my classes to other teachers to observe. I think we know whether children are enjoying classes from the classroom atmosphere. In such classrooms, the whole class seems united and all the children seem to be learning for a common goal. We can cultivate our competencies in assessing children's affective attitudes from the classroom atmosphere through the experiences of observing pupils.
6.1.12	5th	I think that promotion of pupils' motivation is important, because I do not want to make my pupils dislike mathematics.
6.1.13	8th	If pupils are motivated to understand the content, I am sure that their learning can progress.
6.1.14	8th	We use whole-class teaching for most of the class duration. Thus, we can easily compare motivated and unmotivated students. We can see how many pupils are unmotivated and who they are.
6.1.15	5th	Children sometimes tell me that they want to do the same activity again. Even children who are poor at mathematics try to respond to my questions when they are motivated to learn. So, I prepare small-step questions so that every child can follow. Pupils want to continue to study during break time. They practise similar problems at home autonomously. Being positive and careful in tasks suggests how much pupils are motivated to learn mathematics on particular occasions.
6.1.16	8th	I walk between the desks in order to provide pupils with individual support while they are working individually. Pupils who are unmotivated are not willing to ask questions even if they don't know the procedure. When they have lost their motivation to learn, their expectation of mastering the content gets weaker.

6.1.17	8^{th}	Teachers may miss a particular pupil's lack of motivation in some cases. Such pupils may try hard to deal with the tasks in class and respond to questions correctly. But if they try to learn carefully or review at home, they do not get good marks in the tests. In these cases, teachers may not notice the pupil's lack of motivation until they see his or her deteriorated test performance.
6.1.18	5^{th}	Children of today don't know understand about co-operation and mutual support with peers. For example, they are poor at discussion skills such as uderstanding what others are saying and expressing their views in public. I think it is important to learn how to communicate with peers in mathematics classes. Communication with peers should not be limited to exchanging greetings. They need to learn how to discuss abstract concepts with peers.
6.1.19	5^{th}	I would like to cultivate the children's attitudes so that they accept each other in a classroom. I believe that this is as important as promoting their mathematics attainment. We cannot persuade pupils how important this is by words. Children can learn it through observing how I accept individual children.
6.1.20	5^{th}	Trust between my pupils and me is important to make pupils feel secure. If a good relationship is not built between teacher and pupils and between peers, children will not present their views frankly. Basically, the capabilities of the teacher in building up such relationships in a classroom make mathematics classes successful. Teachers should not blame their pupils for lack of understanding or misbehaviour in a class. Teachers should examine their own attitudes. Thus, teachers have responsibilities regarding the extent to which pupils feel secure in mathematics learning.
6.1.21	8^{th}	Pupils' sense of security does not only depend on their mathematics attainment. I think it depends on the relationships between peers and environmental factors. Therefore, teachers should create a classroom atmosphere so that the pupils feel secure in learning mathematics.
6.1.22	8^{th}	Pupils are more likely to be conscious about getting a right answer rather than the process of how they have been thinking about finding the answer. Most of the tasks in mathematics class require one definite answer. So, I think, pupils are in a situation in which they have anxiety more often than literature classes where pupils can enjoy exchanging views. Children who raise their views seem to favour discussion methods, but for the pupils, who do not have their own opinions or who do not feel easy about speaking in public, discussion methods cause anxiety. Some pupils feel more relaxed in taking part in practical work or experiments, but this also causes pupils' anxiety if they are not accustomed to this learning method or are not sure about the procedure. They must be just as upset. Using computers may be beneficial to reduce pupils' anxiety by learning individually. But, focusing on learning through computers may make the pupils feel isolated and may not reduce their anxieties.
6.1.23	5^{th}	I think that promoting pupils' sense of security may be less emphasised than three other aspects, say, enjoyment, motivation and sense of progress, in my mathematics classes.

6.1.24	8^{th}	I think pupils' sense of security is not emphasised greatly in my mathematics classes.
6.1.25	5^{th}	Pupils may notice whether they are enjoying activities, feeling able to try to work hard or whether they understand the content. But, I suppose, pupils are not conscious about whether they feel secure or not in mathematics classes. I don't think they face situations where they feel anxious in mathematics classes very often.
6.1.26	8^{th}	I focus on how I can support my pupils in the improvement of their mathematics attainment, because I believe that their affection for mathematics will be promoted if they believe they can do well. But when I saw the pupils' responses in this questionnaire survey, I realised that my pupils might feel anxiety in classes. Then, I realised that with some pupils whose attainment dropped suddenly this might be due to problems with their classmates or other problems in their life which are not directly linked with learning mathematics itself. I think that some support on this must be needed.
6.1.27	5^{th}	Mathematics knowledge and competencies are a fundamental requirement in the children's later life. Therefore, it is important to ensure all the pupils believe that they are making progress in developing mathematics competencies.
6.1.28	8^{th}	The most important aim of mathematics classes is letting the pupils have a sense of progress. This is different from improving actual attainment. Pupils' sense of progress can provide them with confidence in learning mathematics. Such confidence will promote their motivation to learn mathematics and enjoyment in learning mathematics.
6.1.29	5^{th}	Children's actual attainments do not necessarily link to their fondness for learning mathematics or their confidence in learning mathematics. You can find many elementary school pupils who don't like mathematics, even though their attainment is high. See mathematics education in other countries. Children say that they like mathematics in the countries which consider individual differences. Learning mathematics is not a pain for them because they learn according to their attainment, the goal is within their reach. Japanese pupils are encouraged to tackle difficult tasks and come to dislike mathematics. But, parental expectations seem to be changing these days. Parents focused on improvement in their children's attainments decades ago, but parents of today seem to encourage their children's development in forming personality and relationships between peers. The social trend also seems to be changing. The current educational reforms with the reduction of the curriculum content and lesson amount may affect pupils' attainment negatively. But, I think this policy will work positively to promote pupils' affective aspects.
6.1.30	5^{th}	I want my pupils to learn and develop mathematical thinking such as analogy and deductive thinking. I don't think half of 5^{th} graders can understand what these are. But I continue to tell them about the importance of developing these competencies. Then I hope that the number of children who understand the meanings of developing such competencies will increase.

6.1.31	5th	I think that promoting pupils' feeling able to understand' is more important than their feeling able to manage tasks. It is important to enable them to understand the reasoning of the formulas and procedures.
6.1.32	5th	Developing pupils' mathematical ideas sounds vague. But, I think developing their inductive thinking competencies is most important. "Inductive thinking competencies" means the process of collecting as much information as possible to lead to a conclusion. For instance, children tried to establish the area of many triangles and then made a formula [the base x the height x ½]. This is inductive thinking. Then, it is important to make them notice that such inductive thinking can be used for establishing the area of a trapezium. Otherwise, children have to memorise formulas and how to manipulate them. Learning through inductive thinking gives children inspiration. Each unit contains opportunities to develop children's inductive thinking. I value such opportunities.
6.1.33	5th	I think educational aims may differ in the units on number and shape. I would like to emphasis the acquisition of fundamental knowledge and skills in the unit of number, while I would like to promote pupils' motivation and interest in the unit on shape. In other words, I think pupils need to master the way of solving problems accurately and quickly in the unit on number, while they need to learn to examine a problem in various ways with wide ideas in the unit on shape.
6.1.34	5th	Children are likely to feel progress in mathematics learning when they get higher marks in tests, express their views in discussion and get approval for their views. Especially, children take approval and praises from classmates, parents and the teacher seriously as indicators of progress. Such approval and praise gives the child confidence in mathematics learning. Getting good marks in tests becomes a clear aim for the children and promotes their motivation to study. I do not think such a goal in itself is wrong. But children put too much stress on better results, as a result, they tend to neglect processes such as trial and error learning.
6.1.35	8th	A sense of progress in mathematics classes is indicated when pupils can understand the explanation in the textbook rather than memorising the formula.
6.1.36	8th	In my view, a sense of progress in mathematics is indicated by the extent to which individual pupils can understand in the class and the extent to which they absorb that understanding.
6.1.37	8th	It is important for pupils to proceed in their mathematics learning by understanding why they got a wrong answer. I let my pupils write down why they got wrong answers after examination in order to encourage them to find out what their weakness was. Many pupils wrote they made mistakes due to their carelessness in the examination setting. I suppose that they believed that they failed to apply the formula, which they had memorised for the examination, due to carelessness. I observed that pupils who had tried to understand the principles could find out why they got a wrong answer through rereading the explanation in the textbook. But these pupils were few and they are normally the better performers at mathematics.

6.1.38	8th	Pupils who could present original ideas and clear proof of their ideas often impressed me. It is important to encourage them to develop their mathematics ideas. I think that developing pupils' mathematics ideas can enhance pupils' interest, motivation, sense of accomplishment and confidence.
6.1.39	8th	Although many pupils cannot see progress without improvement in test results, I can observe pupils' progress from the way they develop solutions. Pupils who have progressed, became accustomed to thinking through problem logically and presenting their views clearly. I can observe much change from not only the examination but also from presentation in class and ways of taking notes. Therefore, I want to have opportunities to elicit pupils' views in a class and examine pupils' notebooks as many as possible. It is not a true sense of progress and obtain right answers. It is important to encourage pupils to find solutions by themselves and come to a conclusion. I want to emphasise the process when I think what pupils' sense of progress is.
6.1.40	8th	Pupils set up goals such as the extent to which they need to improve their mathematics attainment for the requirement of the high school of their choice. They reflect on their learning by examining the extent to which they achieve their goals in the tests. They observe their improvement from the test results easily. I myself do not think this is a wrong measure. I encourage my pupils to set up the optimum level of goals and make an effort to achieve their goals.
6.2.1	5th	I don't think that explaining the content through drawing pictures on the blackboard is enough to promote my pupils' understanding. It is especially useful for pupils to learn volume and capacities through observation. Observation is effective in promoting pupils' understanding of not only shapes but also numbers better than verbal explanation can achieve.
6.2.2	5th	Pupils are more likely to be able to keep the learning content in long-term memory when they learn it through experience than when they memorise the formula. Pupils can remember the experience itself. They may forget the formula easily, but they are less likely to forget the experience.
6.2.3	5th	I always try to employ a problem-solving learning style. Firstly, the pupils think individually or in a group. Practical activities are quite often employed at this stage. Afterwards, the pupils share the ideas in class and this leads to a conclusion with my support. The child finds his or her ideas first. The teacher can plan the lesson based on an understanding of the individual pupil's ideas and attainments. Therefore, this teaching method is effective in promoting pupils' mathematical ideas, I believe.
6.2.4	5th	Adopting a trial and error learning style through activities is better for developing pupils' mathematical ideas than explaining the concept to the pupils on the blackboard. Pupils can note their misunderstanding, adapt what they have learned before to the new problem and link existing knowledge and new findings, through manipulating materials and experiences
6.2.5	8th	Adoption of practical activities can avoid evaluation and comparison between pupils based on their performance. So such activities can promote the pupils' individual interest and learning preferences. Naturally, pupils feel able to take part in the activities and learn mathematics.

6.2.6	5^{th}	Children feel more familiar with the learning content when they know the concept can be adopted in their everyday life.
6.2.7	5^{th}	Children of today do not know how the concept they have learned in mathematics classes can be used in their everyday life. I would like the pupils to learn this through taking part in practical activities.
6.2.8	5^{th}	Children of today lack experiences of dealing with raw materials in their life, due to a life style with many conveniences. They have not developed a sense of quantity or weight, which they were previously expected to acquire in everyday life. We need to remedy this lack in mathematics classes.
6.2.9	5^{th}	There is normally quite a large difference in the knowledge they have on a topic between pupils who are attending cramming schools and those who aren't. But, in the lessons, adopting practical activities can reduce such differences. In other words, all of the pupils can take part in the activities on the same level. Sometimes, pupils who are not so good at mathematics present a unique view. They have not developed their mathematics abilities to get higher marks in the tests, but they can present their competencies such as creativity, analogy and construction of the concept through activities. The children get approval from their peers and have confidence in doing mathematics. Naturally, they try harder to learn afterwards.
6.2.10	5^{th}	The learning content becomes more abstract. It is difficult to talk of abstract concepts in a concrete way. The topics where we cannot use concrete materials increase by 5^{th} grade, especially in relation to number.
6.2.11	5^{th}	The content pupils learn in mathematics classes cannot necessarily be linked with their experiences in everyday life. The content based on abstract concepts and the content aiming to develop pupils' abstract concepts increase by 5^{th} grade. Pupils are also developing their abstract thinking competencies. They become able to think without concrete materials. In such cases, employing practical activities can present obstacles to developing abstract thinking competencies.
6.2.12	8^{th}	As you know the mathematics the pupils have to learn in senior high school are absolutely abstract. So, pupils need to be trained to develop their abstract thinking even at junior high school level.
6.2.13	5^{th}	If the pupils are not accustomed to learning through activities, they may be confused by learning mathematics in this way, especially, children, who memorise formula before class, and cannot think flexibly.
6.2.14	8^{th}	Some teachers are good at lessons with practical activities, but others are not. So this teaching method is difficult to employ because of maintaining equality between classes.
6.2.15	5^{th}	Children may enjoy classes employing practical activities. But, it would be a negative experience if children did not learn much through such activities.
6.2.16	8^{th}	Pupils do not seem able to apply what they have learned through activities to other problems. So, learning mathematics through activities does not lead to improvement of test results. Pupils enjoy practical activities, but learning mathematics through activities does not necessarily lead to the promotion of attainment.

6.2.17	5^{th}	Pupils actually enjoy learning mathematics with activities or concrete materials. But they come to dislike listening to abstract explanations, and concentrate less on practising exercises. They try to avoid practice exercises, which require patience and tenacity.
6.2.18	5^{th}	I know mathematics lessons using practical activities become great fun. But, if we employ practical activities, we cannot secure the time for mastering fundamental knowledge and skills. It is not possible to employ practical activities very frequently, because of the tight curriculum and limited class duration.
6.2.19	5^{th}	Individual preferences for learning mathematics through activities seem to exist. Children, who usually do well at doing calculations and so on, do not necessarily enjoy practical activities. Some of them are not familiar with doing activities on estimation. Others are not good at learning in a group.
6.2.20	5^{th}	A computer can make very precise drawings. Children cannot draw shapes well, but they can draw shapes with the computer easily. In these cases, I want to use the computer. Children can understand some concepts more easily by learning through their visual senses.
6.2.21	8^{th}	Pupils are interested in using a computer for computer graphics. Naturally, I believe, the pupils' enjoyment and motivation are promoted.
6.2.22	8^{th}	I sometimes use CAI, Computer-assisted instruction, for individual learning. Pupils can choose the problems. They can proceed at their own pace. I help them if they cannot operate it.
6.2.23	8^{th}	Statistics using Excel have been taught since a few years ago. Along with the popularisation of using computers in classes, the content we can offer in mathematics classes is getting wider.
6.2.24	8^{th}	I don't think using computers can develop my pupils' mathematical ideas as well as discussion. Interactions between teacher and pupils, and between pupils, are indispensable, in promoting pupils' understanding and developing their mathematics ideas. Learning mathematics with computer programmes lacks such interaction.
6.2.25	8^{th}	Children may have too great expectations of learning mathematics by computers. They misunderstand their interest in using the computer as interest in learning mathematics. Actually, children enjoy learning mathematics through computers more than doing practice in their notebook. But such enjoyment does not lead to improvement of their attainment. Even among the high achievers taking additional mathematics classes, their interest in using computers seems to vary. Some want to make programs, others want to use computers for input. I don't think using computers can meet children's expectations. Then it may produce disappointment.
6.2.26	5^{th}	Few teachers can use computers. Elementary school teachers need to teach most of the subjects. We need to prepare for all the subjects. It is difficult to find time to acquire the skills of operating computers.

6.2.27	5th	I would like to use computers in mathematics classes because children are probably interested in learning mathematics by using computers. But the computers at my school were acquired long ago. This means that the new software cannot be adjusted for the computers. Anyway, I think, computer software programmes which help pupils with learning mathematics autonomously have not been developed yet
6.2.28	8th	Enough computers are equipped so that individual pupil can use computers. Lots of software is also prepared. So, I sometimes adopt CAI programs in my mathematics classes.
6.2.29	5th	Specialists write the textbooks. The content is well organised and examples are well selected. Therefore, pupils' understanding is naturally promoted if they learn through the textbook
6.2.30	8th	I believe that reading textbooks is basically the most effective way to promote pupils' understanding. I make my pupils read the textbook first, and support them when they feel difficulty in understanding the content written in the textbook or when they fail to solve problems repeatedly.
6.2.31	5th	Children have their own textbooks. So they can check their understanding when they forget the formula or procedure. Pupils feel secure because they know the textbook contains the information they need to solve the problems.
6.2.32	5th	I make my pupils find the solution through discussion. After discussion, I make them use textbooks in order to confirm whether their finding is correct by checking with the formula written in the textbook.
6.2.33	5th	I always use textbooks. I cannot find enough time to prepare the materials instead of textbooks. And, I want to use the time for more individual support such as clarifying individual needs and supporting such individual needs.
6.2.34	5th	Many children cannot understand the textbook explanations, so I need to explain the description in the textbook in plainer words. Children of today lack vocabulary, probably due to the lack of communication with adults in daily life. In addition, textbooks of today avoid detailed explanation. Thus, learning mathematics through reading a textbook must be difficult for the children.
6.2.35	8th	Mathematics textbooks used in Japanese schools are not suitable for learning oneself. Mathematics lessons were, traditionally, undertaken with the teacher's explanation in a whole-class unit. So, we have not developed learning styles where the individual pupils learn by themselves. Mathematics textbooks do not contain enough explanation. So, I need to make more substantial explanations of the content of the textbook and support my pupils to promote their understanding of the content.
6.2.36	5th	The mathematics textbooks present too much detailed explanation. So pupils can read from the beginning to the conclusion before they try to think of the problem by themselves. Children feel as if they are able to understand the content without any deep thinking. Then they rely on the formula and procedure. Our attempt to develop children's mathematical thinking cannot be achieved.

6.2.37	5th	I normally start my lessons with overall explanation to promote my pupils' understanding of the content. Next, I encourage them to put forward their views on the topic based on understanding obtained through my explanation. I conduct the lesson by giving them opportunities to raise their views as much as possible. I take the role of chairperson. After they reach a conclusion, I encourage them to use textbooks to confirm their understanding. If we rely on textbooks from the beginning, I don't think we can develop pupils' mathematical ideas.
6.2.38	5th	Topics presented in textbooks are not linked with pupils' experiences in their daily life. I encourage my pupils to generate problems by themselves. Taking up a more familiar topic or doing some practical activities will promote their motivation to think and learn.
6.2.39	5th	Mathematics lessons which emphasise explanation by the teacher can convey the necessary knowledge and skills to the pupils accurately. I have tried to adopt exploratory methods, which enable the pupils to discuss the topic and lead to a conclusion, in my classroom, but I found that this can cause confusion if the teacher cannot help the pupils to reach the conclusion well. More teacher-led ways seem safe to avoid pupil confusion.
6.2.40	8th	They cannot enjoy learning mathematics or be motivated to learn mathematics, if they cannot understand the lessons. So, I want to make them feel that they are coming to understand something or are doing something well in each lesson. Taking up the pupils' views through questions and answers is effective in making them have such feelings.
6.2.41	5th	I encourage the pupils, especially those who are not good at mathematics, to put forward their views. I think they will come to have confidence when their views are approved.
6.2.42	8th	It is important to take up pupils' views. Pupils may not be able to read a correct conclusion directly. But, if they know that their thinking is not in the wrong direction, they are motivated to rise to the challenge and to solve other problems as well.
6.2.43	5th	Pupils who perceive themselves as good at mathematics can concentrate on learning for one hour. But pupils who perceive themselves poor at mathematics and need time to understand may lose their motivation to learn if they cannot understand what they are being asked. It is necessary to arrange questions in small steps for those pupils. I try to give questions according to the individual's current level of attainment. They can answer my questions, get approval and come to have confidence.
6.2.44	5th	Pupils are motivated to learn mathematics when they feel approval from the teacher and peers. So arranging the classroom ethos so that pupils can support each other is important. I tell them not to laugh at classmates when they make mistakes. I also tell them not to be afraid of making mistakes. We can learn from making mistakes or analysing others' mistakes. It is more important to elucidate pupils' idea through interaction than leading quickly to a conclusion. The classroom ethos is changing, in favour of supporting each other.
6.2.45	5th	I try to avoid putting too much emphasis on explanation. Children are happy with finding answers from their inspiration. Cultivating their sense of number is also important. Encouraging their autonomous learning is very important. If the teacher puts too much emphasis on explanation, it might make the children dislike mathematics.

6.2.46	8th	The attainments of low achievers and high achievers are very different. Teachers need to seek out the appropriate level of explanation to promote all of the pupils' motivation. If we emphasis the acquisition of fundamental knowledge and skills for the pupils, high achievers may lose their motivation to learn. If we prepare only problems which need high competencies, low achievers cannot keep up with the class. We need to seek out the appropriate level of difficulty for lessons so that all of the pupils can be happy with the lessons.
6.2.47	8th	Large differences exist in the attainment of pupils. Pupils attending cramming schools can finish tasks very quickly. Pupils can set up individual goals in individual learning sessions. Pupils seem motivated to learn mathematics in this way.
6.2.48	5th	I think that it is most important to support the pupils according to individual need.
6.2.49	5th	Pupils in my class can be divided into three groups. One group is for the pupils who have already learned the content at cramming school. Another group is for the pupils, who can understand my explanations. The rest is for the pupils, who have difficulties in understanding my explanations. While pupils are doing exercises, I go directly to pupils explaining difficulties. Pupils can have break time after they complete the appointed tasks. I continue to teach the pupils who have not finished through break time.
6.2.50	8th	After I explain the main principles and ask the class some questions and make them answer, to confirm most of them have understood the learning content, I have an individual learning session. The textbook contains exercises. While pupils are doing these exercises, I normally walk between the desks and support the pupils who cannot complete the exercises by themselves. One third of pupils in a class need individual support. I give pupils a pre-test soon after the academic year starts. I select several pupils, who need support. In the individual learning sessions, I try to support these pupils as much as possible.
6.2.51	5th	Pupils can know which problems they have not mastered by themselves. While I make them do exercises, I observe how they are dealing with the problems, understand the extent to which they have mastered the content and think out how I can support their needs. In this sense, keeping time for doing individual exercises is very important.
6.2.52	5th	Children may forget how they have found the answer sooner or later. So, making them do exercises repeatedly is very important to ensure their understanding.
6.2.53	5th	The individual teaching method may satisfy individual differences, but I believe that all of the pupils can achieve mastery up to a certain level. I think it is better to encourage both high achievers and low achievers to help other. I ask the pupils who have finished earlier to write their solution on the blackboard. Thus, these pupils learn the same problem twice, once in their notebook and then on the blackboard. I let them write out the thinking process, so these pupils also notice their misunderstandings. Slow learners can learn from high achievers. Higher achievers can explain to their peers more plainly than the teacher.

6.2.54	5th	Pupils have come to compare their attainments with others' by 5th grade. However, if teachers compare pupils' attainments and offer them different treatment according to their attainment, class management is not easy. I think that class management, which values relationships and mutual support between peers, is important, especially at elementary school level. If teachers take test results or pupils' mathematics attainments seriously, the pupils will not be happy. They will lose their motivation to learn mathematics, and feel anxiety. Enjoyment in learning is very important at elementary school level.
6.2.55	8th	I want to employ whole-class discussion as much as possible. Mathematics problems have only one right answer, but there are a lot of routes to reach the answer. I expect my pupils to find out a lot of routes and select the most effective route, which can avoid mistakes. Both cultivating pupils' competencies to widen the possible solutions and selecting the most effective solution is important.
6.2.56	8th	Pupils can meet more different perspectives in a large group than a small group. Pupils can be trained to explain logically. I expect the pupils to have the competencies to be able to examine a problem for various solutions, but normally, pupils tend to stick to their favourite solution. If I gather various solutions and explain them one after another to the pupils, they will not listen to me. But if pupils take part in discussion they try to understand others' views.
6.2.57	5th	I avoid giving the right answer to them from the beginning. I want my pupils to set out their views positively and find different opinions to their peers, examine the appropriateness of each solution and revise their ideas if necessary. Especially in the unit of shape, pupils can have various perspectives on one problem. So, I try to pick up their views as much as possible.
6.2.58	5th	Pupils attending cramming schools sometimes do not know why the solution is correct, because they learn the formula and procedure. So, I make them explain the solution to others. They can find that explaining the solution to others is difficult. They can deepen their understanding through explaining to others.
6.2.59	5th	Children feel secure when they talk about their uncertainty to their peers and find that other children have the same questions. Then they are motivated to solve the problem together. Sharing views with peers is also enjoyable. Children feel relaxed when learning mathematics in a group.
6.2.60	5th	Learning mathematics with peers in a group has two purposes. One is promoting their mathematics competencies. The other is learning how to build a good relationship with peers through learning mathematics. I think it is important to learn how to co-operate with peers through learning mathematics together.

6.2.61	5th	Only certain pupils put forward their views in whole-class discussion. Pupils who have studied the learning content at home or at cramming school, before the class, can present their views. Some pupils are not willing to suggest things, even if they understand the content. They think that others will suggest solutions. Many pupils cannot take part in discussions positively. They cannot conceptualise what their peers are raising in the discussion. So discussion is beneficial only for the pupils who give their opinions positively. High mathematical attainment is required to take part in discussion positively in mathematics classes. This is different from discussion in language or social sciences, which can involve a wide range of pupils in discussion more easily. I sometimes make the high achievers wait for other pupils to express opinions.
6.2.62	5th	Not all of the pupils can raise their views in a whole-class discussion. Time constraints allow a certain number of pupils to raise their views. Some pupils do not like raising their views in the whole class. I suppose they wait for someone else. Pupils feel able to raise their views in a group. I employ group discussion sometimes, so that all of the members in a group can put forward their opinions.
6.2.63	5th	Pupils have a wide range of attainment. So, it is difficult knowing how to divide pupils into groups. For instance, if we put the pupils into a group randomly irrespective of their attainment, there are some pupils who may express their views, and others, who cannot understand what is discussed. If we make groups according to attainment, the group with higher attainment may accomplish great discussion, but no one in the group with lower attainment may be able to express any opinions.
6.2.64	8th	Pupils have not developed their competencies of discussion yet, so I don't think they can share their views effectively. They can present some knowledge. But, it is difficult for them to express their own views or respect the views of others.
6.2.65	5th	I cannot observe all of the groups at one time. So even if they raise a good point, I may fail to take it up in the class.
6.2.66	8th	Each lesson contains important points, which cannot be missed. If we leave them in a group to learn mathematics, I am afraid they may miss some important points.
6.2.67	5th	Higher achievers may state the answers and others may just follow that answer. Then, low achievers or unmotivated pupils will not be willing to try to think the solution out by themselves. I would like to emphasise individual learning rather than group learning. It is important for the pupils to think and find out the solutions by themselves.
6.2.68	8th	We have to cover a lot of curriculum content in a limited time duration. It is difficult to adopt discussion in mathematics classes, because of time constraints.
6.3.1	8th	I think it is important to select teaching methods according to the learning content. Different teaching methods are needed to teach the units of 'number' and 'shape'. I choose the teaching method which can convey the learning content clearly and ensure that pupils feel free to be involved in learning.

6.3.2	5th	I select the teaching method according to the pupils' understanding of the learning content. This is because they may not be fully involved in activities if such activities are not well matched with their understanding level. Full involvement in activities, in turn, will promote pupils' understanding. So, I think it is important to adopt different teaching methods in the introductory, middle and conclusion stages, even in one topic.
6.3.3	5th	I adopt various teaching methods to explain one problem. I think explaining the problem with several teaching methods can promote the understanding of the pupils who are poor at mathematics. They may not understand the learning content from my explanation, but they may understand through practical activities. Therefore, teaching them through a single teaching method is not sufficient.
6.3.4	8th	I normally explain the learning content to the pupils and ask them some questions. But, this routine teaching method is not enough in a unit the pupils feel unfamiliar with. I employ activities to inspire their interest in the content, make them read a textbook, take time to explain the content and give them questions to ensure their understanding, make them do exercises and increase opportunities to provide individual support. Then their understanding of the new unit is well promoted.
6.3.5	5th	I believe that pupils come to learn mathematics by whatever teaching method is often used and they have good experiences such as experiencing approval or coming to understand through that teaching method. Therefore, I don't think it a good idea to select a single teaching method at elementary school level. Rather, they should experience various teaching methods.
6.3.6	8th	Pupils prefer the teaching method which they are accustomed to and with which they have had a good experience. Therefore, pupils' preference for teaching methods is changeable. I think it is important to employ various teaching methods in mathematics classes so that I can deal with such changeablity.
6.3.7	5th	I'll try to adopt different teaching methods across classes so that the pupils can maintain their motivation to learn mathematics. I sometimes ask them how they want to deal with a problem. I let them choose the learning method. Naturally, they are motivated to learn.
6.3.8	5th	I employ various teaching methods in one class. Preparing several activities in one lesson promotes pupils' enjoyment, motivation and satisfaction.
6.3.9	5th	Pupils' mathematical attainments and learning speed are quite different in the classroom. Employing various teaching methods in mathematics classes can make pupils have a sense of accomplishment, understanding and satisfaction.
6.3.10	5th	Different pupils seem to have different values, even if they have similar mathematics attainment. I don't think all of the higher achievers prefer abstract thinking and lower achievers need some tangible materials. Some higher achievers prefer concrete thinking, while other higher achievers are fond of abstract thinking. Employing various teaching methods in mathematics classes is important to meet such differences.

6.3.11	5th	I think explaining a problem with various teaching methods can promote motivation of the pupils, who have already got some knowledge from home or cramming school. If I employ a single method such as teaching a class with the textbook and doing exercises contained in the textbook, pupils cannot be satisfied, because they have already done this elsewhere. I try to find alternative ways to explain the problem and let my pupils discover alternative ways. Then, lessons can inspire curiosity and the motivation of higher achievers.
6.3.12	5th	The educational aim of mathematics classes is not only to improve pupils' mathematical attainment but also to train pupils to learn in a group by listening to others' views and expressing their views. Promoting pupils' mutual development is important. In this sense, employing only individualised methods is not sufficient. However, some pupils do not like learning with others. They want to think, try and learn by themselves. They prefer to ask some questions directly of me. I also need to employ individual learning for such pupils.
6.3.13	5th	Elementary school education does not aim to promote one particular competence, rather it aims to promote as wide a set of competencies as possible through learning. So, I think that it is not appropriate to select a teaching method at this stage. For example, pupils' competencies of understanding the content through hearing can be cultivated through listening to the teacher's explanation. Pupils learn how to share views with peers through taking part in discussion. Similarly, other teaching methods can cultivate pupils' other competencies. Employing various teaching methods in mathematics classes will cultivate pupils' various competencies.
6.3.14	5th	Employing various teaching methods is important, to make pupils notice the advantages of teaching methods which they have not liked previously. For instance, some pupils don't think they can promote their understanding through discussion. But if they actually take part in discussion and feel some progress, they come to like learning through sharing ideas with others. If they know only a single learning method, they may not be able to find solutions when they meet problems in later life. But if they know various learning methods and are accustomed to such methods to a certain extent, they can try several methods to find the solution.

Table 7.1.1: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of general self-concept at 5th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	648	3.53	1.32	648	3.57	1.30	647	3.53	1.27	646	3.63	1.27	646	2.56	.94
	L	802	3.10	1.31	802	3.01	1.32	797	2.90	1.26	799	3.19	1.31	801	2.27	.87
		t=6.124, df=1448, p<.01			t=8.063, df=1448, p<.01			t=9.459, df=1378.659, p<.01			t=6.409, df=1443, p<.01			t=6.027, df=1334.307, p<.01		
UC	H	648	3.40	1.55	647	3.42	1.43	647	3.19	1.42	645	3.18	1.33	644	1.53	.78
	L	799	3.25	1.57	800	3.27	1.54	796	3.02	1.48	796	3.07	1.40	800	1.53	.82
		t=1.889, df=1445, p>.05			t=2.004, df=1417.417, p<.05			t=2.166, df=1441, p<.05			t=1.630, df=1439, p>.05			t=.064, df=1442, p>.05		
RT	H	647	2.99	1.20	646	2.90	1.28	646	3.16	1.31	646	3.61	1.30	644	3.54	.99
	L	799	2.71	1.14	801	2.67	1.25	796	2.79	1.30	799	3.28	1.35	801	3.31	.94
		t=4.568, df=1444, p<.01			t=3.455, df=1445, p<.01			t=5.353, df=1440, p<.01			t=4.688, df=1443, p<.01			t=4.389, df=1341.675, p<.01		
TE	H	648	3.58	1.17	648	3.47	1.20	647	3.57	1.21	647	4.02	1.07	640	3.77	1.00
	L	801	3.29	1.26	802	3.15	1.30	797	3.18	1.29	800	3.64	1.27	798	3.48	1.07
		t=4.573, df=1447, p<.01			t=4.807, df=1448, p<.01			t=5.783, df=1442, p<.01			t=6.125, df=1442.559, p<.01			t=5.207, df=1402.392, p<.01		
IW	H	648	3.17	1.33	648	3.26	1.38	647	3.45	1.32	647	3.73	1.22	639	3.64	.95
	L	802	2.71	1.28	802	2.85	1.38	798	2.95	1.39	800	3.24	1.38	799	3.37	1.01
		t=6.588, df=1448, p<.01			t=5.686, df=1448, p<.01			t=6.917, df=1443, p<.01			t=7.047, df=1434.339, p<.01			t=5.270, df=1399.526, p<.01		
IH	H	647	2.54	1.25	647	2.77	1.33	646	2.97	1.35	647	3.44	1.32	645	2.95	1.05
	L	796	2.37	1.21	801	2.48	1.33	798	2.58	1.35	799	3.01	1.42	799	2.73	1.01
		t=2.530, df=1441, p<.05			t=4.041, df=1446, p<.01			t=5.475, df=1442, p<.01			t=5.873, df=1444, p<.01			t=3.985, df=1442, p<.01		
WD	H	648	3.40	1.20	648	3.37	1.19	647	3.38	1.21	647	3.60	1.21	640	3.46	1.07
	L	802	2.96	1.16	802	2.93	1.24	798	2.89	1.24	800	3.11	1.29	790	3.09	1.09
		t=7.071, df=1366.122, p<.01			t=6.775, df=1448, p<.01			t=7.607, df=1443, p<.01			t=7.424, df=1445, p<.01			t=6.423, df=1428, p<.01		
GD	H	648	3.36	1.19	648	3.40	1.17	647	3.38	1.17	646	3.43	1.18	639	2.55	.89
	L	802	2.94	1.23	802	2.90	1.23	798	2.90	1.22	799	3.07	1.25	796	2.28	.92
		t=6.596, df=1448, p<.01			t=7.844, df=1448, p<.01			t=7.463, df=1443, p<.01			t=5.569, df=1443, p<.01			t=5.712, df=1433, p<.01		

Table 7.1.2: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of general self-concept at 8th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	987	2.88	1.38	987	2.72	1.31	985	2.60	1.22	983	2.83	1.25	983	1.43	.62
	L	1087	2.78	1.34	1081	2.59	1.26	1075	2.47	1.18	1079	2.68	1.25	1078	1.40	.59
		t=1.624, df=2072, p>.05			t=2.244, df=2066, p<.05			t=2.517, df=2058, p<.05			t=2.554, df=2060, p<.05			t=1.224, df=2015.479, p>.05		
UC	H	987	3.13	1.53	986	2.92	1.38	983	2.64	1.27	982	2.59	1.21	982	1.39	.70
	L	1087	2.99	1.51	1081	2.87	1.40	1075	2.59	1.29	1077	2.55	1.22	1080	1.31	.65
		t=2.175, df=2072, p<.05			t=.858, df=2065, p>.05			t=.849, df=2056, p>.05			t=.697, df=2057, p>.05			t=2.770, df=2002.447, p<.01		
RT	H	987	2.69	1.19	983	2.53	1.22	984	2.92	1.26	982	3.26	1.24	978	3.13	1.18
	L	1085	2.57	1.18	1078	2.38	1.13	1076	2.67	1.21	1078	3.07	1.26	1075	2.96	1.11
		t=2.301, df=2070, p<.05			t=2.832, df=2004.371, p<.01			t=4.582, df=2058, p<.01			t=3.409, df=2058, p<.01			t=3.506, df=2005.020, p<.01		
TE	H	987	3.53	1.18	987	3.38	1.19	985	3.65	1.17	982	3.99	1.04	979	4.15	.96
	L	1087	3.23	1.27	1080	3.03	1.23	1075	3.25	1.24	1079	3.68	1.13	1071	3.87	1.04
		t=5.628, df=2072, p<.01			t=6.509, df=2065, p<.01			t=7.518, df=2058, p<.01			t=6.443, df=2058.896, p<.01			t=6.360, df=2052.583, p<.01		
IW	H	987	3.32	1.25	987	3.49	1.26	985	3.73	1.22	983	3.93	1.10	978	3.90	.86
	L	1087	3.16	1.28	1081	3.18	1.30	1075	3.45	1.30	1079	3.68	1.21	1074	3.78	.92
		t=2.867, df=2072, p<.01			t=5.585, df=2066, p<.01			t=4.984, df=2057.082, p<.01			t=4.796, df=2059.994, p<.01			t=3.138, df=2048.497, p<.01		
IH	H	987	3.10	1.29	987	3.40	1.33	985	3.62	1.31	983	4.13	1.08	978	3.25	1.10
	L	1087	2.86	1.33	1081	3.14	1.36	1074	3.40	1.35	1078	3.94	1.19	1077	2.98	1.07
		t=4.075, df=2072, p<.01			t=4.325, df=2066, p<.01			t=3.738, df=2057, p<.01			t=3.758, df=2058.954, p<.01			t=5.703, df=2021.440, p<.01		
WD	H	987	2.64	1.22	987	2.58	1.21	984	2.54	1.17	983	2.58	1.15	973	1.95	1.03
	L	1087	2.47	1.20	1081	2.37	1.15	1075	2.30	1.10	1079	2.46	1.15	1074	1.78	.84
		t=3.218, df=2072, p<.01			t=4.129, df=2066, p<.01			t=4.794, df=2014.529, p<.01			t=2.420, df=2060, p<.05			t=4.083, df=1886.482, p<.01		
GD	H	987	2.83	1.30	986	2.76	1.29	984	2.67	1.22	983	2.69	1.18	973	1.54	.79
	L	1087	2.67	1.30	1081	2.61	1.26	1073	2.50	1.18	1078	2.56	1.19	1071	1.53	.75
		t=2.884, df=2072, p<.01			t=2.800, df=2065, p<.01			t=3.125, df=2055, p<.01			t=2.643, df=2059, p<.01			t=.354, df=2042, p>.05		

Table 7.1.3: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of mathematics self-concept at 5th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	697	3.47	1.30	697	3.45	1.29	696	3.46	1.24	693	3.62	1.27	694	2.46	.94
	L	740	3.14	1.34	740	3.09	1.36	735	2.95	1.31	739	3.18	1.32	740	2.35	.90
		t=4.693, df=1435, p<.01			t=5.214, df=1435, p<.01			t=7.523, df=1429, p<.01			t=6.392, df=1430, p<.01			t=2.350, df=1414.889, p<.05		
UC	H	696	3.38	1.56	695	3.42	1.47	695	3.18	1.44	691	3.18	1.34	693	1.58	.82
	L	738	3.26	1.57	739	3.27	1.51	735	3.02	1.46	736	3.07	1.39	738	1.49	.79
		t=1.413, df=1432, p>.05			t=2.007, df=1432, p<.05			t=1.984, df=1428, p<.05			t=1.502, df=1425, p>.05			t=2.175, df=1413.966, p<		
RT	H	695	2.99	1.16	694	2.90	1.27	694	3.14	1.31	693	3.64	1.30	692	3.53	.97
	L	738	2.69	1.17	740	2.64	1.26	735	2.80	1.31	738	3.23	1.35	739	3.30	.96
		t=4.904, df=1427.484, p<			t=3.984, df=1432, p<.01			t=4.932, df=1427, p<.01			t=5.822, df=1429, p<.01			t=4.579, df=1429, p<.01		
TE	H	697	3.62	1.20	697	3.54	1.21	696	3.61	1.20	695	4.05	1.10	689	3.90	.95
	L	739	3.23	1.23	740	3.08	1.27	736	3.14	1.28	739	3.61	1.25	736	3.35	1.07
		t=6.066, df=1434, p<.01			t=7.101, df=1435, p<.01			t=7.023, df=1430, p<.01			t=6.971, df=1426.924, p<.01			t=10.297, df=1418.892, p<.01		
IW	H	697	3.26	1.31	697	3.40	1.37	696	3.60	1.30	695	3.78	1.22	690	3.75	.91
	L	740	2.58	1.25	740	2.68	1.33	736	2.76	1.34	739	3.16	1.38	735	3.24	1.02
		t=9.986, df=1435, p<.01			t=10.090, df=1435, p<.01			t=11.952, df=1430, p<.01			t=9.012, df=1426.545, p<.01			t=9.907, df=1419.621, p<.01		
IH	H	693	2.61	1.30	695	2.89	1.36	695	2.97	1.36	695	3.45	1.33	694	2.81	1.05
	L	737	2.27	1.15	740	2.34	1.27	736	2.53	1.35	738	2.97	1.41	737	2.88	1.01
		t=5.212, df=1381.261, p<.01			t=7.909, df=1433, p<.01			t=6.131, df=1429, p<.01			t=6.711, df=1431, p<.01			t=1.280, df=1414.965, p>.05		
WD	H	697	3.34	1.16	697	3.32	1.23	696	3.36	1.24	695	3.55	1.22	686	3.47	1.05
	L	740	2.98	1.21	740	2.95	1.23	736	2.88	1.22	739	3.14	1.30	731	3.05	1.11
		t=5.808, df=1435, p<.01			t=5.809, df=1435, p<.01			t=7.363, df=1421.295, p<			t=6.096, df=1432, p<.01			t=7.330, df=1415, p<.01		
GD	H	697	3.24	1.19	697	3.26	1.22	696	3.30	1.20	695	3.42	1.21	690	2.47	.94
	L	740	3.01	1.25	740	2.99	1.23	736	2.95	1.23	737	3.08	1.22	732	2.35	.90
		t=3.549, df=14535, p<.01			t=4.078, df=1435, p<.01			t=5.433, df=1430, p<.01			t=5.315, df=1430, p<.01			t=2.566, df=1405.776, p<.01		

Table 7.1.4: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of mathematics self-concept at 8th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	1011	2.85	1.38	1009	2.68	1.30	1007	2.57	1.21	1007	2.78	1.26	1006	1.41	.61
	L	1083	2.80	1.35	1079	2.64	1.26	1074	2.50	1.20	1076	2.73	1.25	1074	1.42	.60
		t=.921, df=2092, p>.05			t=.714, df=2086, p>.05			t=1.278, df=2079, p>.05			t=.946, df=2081, p>.05			t= -.140, df=2078, p>.05		
UC	H	1011	3.03	1.51	1008	2.84	1.38	1006	2.53	1.25	1005	2.50	1.18	1007	1.40	.71
	L	1082	3.07	1.52	1078	2.95	1.41	1072	2.69	1.30	1073	2.65	1.25	1075	1.29	.63
		t=.696, df=2091, p>.05			t= -1.890, df=2084, p>.05			t= -2.926, df=2076, p<.01			t= -2.905, df=2076, p<.01			t=3.850, df=2015.238, p<.01		
RT	H	1010	2.70	1.20	1006	2.55	1.20	1008	2.92	1.25	1007	3.28	1.22	1000	3.10	1.19
	L	1082	2.54	1.16	1076	2.38	1.14	1073	2.69	1.22	1074	3.05	1.26	1074	2.97	1.12
		t=3.183, df=2090, p<.01			t=3.309, df=2080, p<.01			t=4.403, df=2079, p<.01			t=4.180, df=2079, p<.01			t=2.546, df=2036.842, p<.05		
TE	H	1011	3.55	1.15	1009	3.36	1.17	1007	3.60	1.17	1006	3.97	1.03	999	4.10	.92
	L	1083	3.21	1.29	1078	3.05	1.25	1074	3.29	1.25	1076	3.70	1.14	1074	3.91	1.08
		t=6.317, df=2087.100, p<.01			t=5.799, df=2085, p<.01			t=5.843, df=2078.882, p<.01			t=5.820, df=2077.106, p<.01			t=4.276, df=2055.703, p<.01		
IW	H	1011	3.47	1.19	1008	3.60	1.21	1007	3.83	1.16	1007	3.99	1.05	999	3.94	.86
	L	1083	3.01	1.30	1079	3.08	1.30	1074	3.35	1.32	1076	3.62	1.23	1074	3.76	.93
		t=8.500, df=2092, p<.01			t=9.459, df=2085, p<.01			t=8.873, df=2070.722, p<.01			t=7.482, df=2062.080, p<.01			t=4.472, df=2070.994, p<.01		
IH	H	1011	3.01	1.27	1009	3.32	1.31	1006	3.57	1.29	1006	4.07	1.10	1003	3.21	1.09
	L	1083	2.95	1.35	1079	3.21	1.39	1074	3.45	1.36	1076	3.99	1.18	1070	3.02	1.09
		t=1.141, df=2091.837, p>.05			t=1.924, df=2085.978, p>.05			t=2.068, df=2077.860, p<.05			t=1.598, df=2079.934, p>.05			t=3.889, df=2062.904, p<.01		
WD	H	1011	2.60	1.22	1009	2.50	1.18	1006	2.45	1.12	1007	2.54	1.16	997	1.90	.96
	L	1083	2.50	1.21	1079	2.44	1.19	1074	2.38	1.15	1076	2.50	1.14	1069	1.84	.92
		t=1.719, df=2092, p>.05			t=1.029, df=2086, p>.05			t=1.406, df=2078, p>.05			t=.810, df=2081, p>.05			t=1.602, df=2064, p>.05		
GD	H	1011	2.75	1.27	1008	2.67	1.26	1006	2.60	1.19	1007	2.65	1.17	996	1.54	.78
	L	1083	2.75	1.34	1079	2.68	1.30	1072	2.56	1.21	1075	2.59	1.20	1067	1.51	.76
		t=.004, df=2092, p>.05			t= -.154, df=2085, p>.05			t=.751, df=2076, p>.05			t=1.054, df=2080, p>.05			t=.784, df=2061, p>.05		

Table 7.1.5: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of perceived mathematics performance at 5th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	557	3.51	1.29	557	3.50	1.33	556	3.47	1.27	554	3.62	1.26	555	2.40	.93
	M	662	3.28	1.29	662	3.27	1.26	658	3.17	1.23	660	3.40	1.26	661	2.50	.90
	L	260	2.84	1.42	260	2.72	1.38	259	2.59	1.36	260	2.85	1.40	260	2.18	.90
		F=22.677, p<.01			F=31.014, p<.01			F=41.938, p<.01			F=31.983, p<.01			F=11.365, p<.01		
UC	H	556	3.44	1.54	556	3.45	1.47	555	3.19	1.46	553	3.18	1.36	555	1.55	.79
	M	660	3.29	1.53	660	3.28	1.47	658	3.04	1.40	656	3.11	1.32	658	1.56	.82
	L	260	3.08	1.67	260	3.18	1.58	259	2.97	1.60	260	2.95	1.51	260	1.43	.79
		F=4.537, p<.05			F=3.318, p<.05			F=2.633, p>.05			F=2.346, p>.05			F=2.879, p>.05		
RT	H	556	2.92	1.18	556	2.85	1.28	556	3.12	1.33	556	3.66	1.26	553	3.54	1.03
	M	661	2.88	1.14	661	2.80	1.23	658	2.98	1.27	658	3.41	1.32	660	3.42	.90
	L	258	2.55	1.24	259	2.54	1.36	257	2.56	1.38	259	2.96	1.44	260	3.13	.96
		F=9.599, p<.01			F=5.724, p<.01			F=16.122, p<.01			F=24.901, p<.01			F=15.631, p<.01		
TE	H	557	3.56	1.15	557	3.42	1.20	556	3.57	1.21	556	4.01	1.10	550	3.96	.94
	M	661	3.42	1.23	662	3.35	1.25	659	3.35	1.23	660	3.87	1.13	659	3.52	.98
	L	260	3.15	1.35	260	2.92	1.38	258	2.97	1.40	260	3.28	1.44	258	3.10	1.20
		F=10.203, p<.01			F=14.918, p<.01			F=19.738, p<.01			F=34.704, p<.01			F=69.704, p<.01		
IW	H	557	3.28	1.31	557	3.40	1.36	556	3.68	1.30	556	3.79	1.21	552	3.78	.92
	M	662	2.79	1.24	662	2.95	1.36	659	3.03	1.30	660	3.42	1.30	656	3.44	.92
	L	260	2.46	1.34	260	2.43	1.35	259	2.46	1.38	260	2.85	1.48	259	2.97	1.14
		F=41.992, p<.01			F=46.769. p<.01			F=83.009, p<.01			F=47.464, p<.01			F=62.974, p<.01		
IH	H	554	2.52	1.29	555	2.84	1.38	555	3.00	1.37	556	3.51	1.34	555	2.70	1.08
	M	659	2.46	1.16	662	2.57	1.28	659	2.72	1.31	660	3.16	1.33	659	2.92	.95
	L	259	2.24	1.27	260	2.22	1.32	259	2.30	1.40	259	2.64	1.46	258	2.91	1.11
		F=4.841, p<.01			F=20.431, p<.01			F=23.940, p<.01			F=36.134, p<.01			F=7.532, p<.01		
WD	H	557	3.30	1.17	557	3.29	1.23	556	3.35	1.24	556	3.57	1.24	549	3.46	1.07
	M	662	3.21	1.18	662	3.19	1.18	659	3.12	1.19	660	3.37	1.20	653	3.25	1.07
	L	260	2.74	1.25	260	2.64	1.31	259	2.60	1.29	260	2.72	1.37	257	2.83	1.10
		F=20.867, p<.01			F=26.778, p<.01			F=33.273, p<.01			F=42.568, p<.01			F=30.522, p<.01		
GD	H	557	3.26	1.19	557	3.25	1.24	556	3.29	1.20	555	3.40	1.19	551	2.46	.97
	M	662	3.16	1.18	662	3.17	1.15	659	3.18	1.17	659	3.25	1.17	657	2.47	.90
	L	260	2.74	1.33	260	2.70	1.37	259	2.56	1.26	260	2.80	1.37	255	2.16	.86
		F=16.856, p<.01			F=19.049, p<.01			F=34.709, p<.01			F=22.016, p<.01			F=11.398, p<.01		

Table 7.1.6: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of perceived mathematics performance at 8th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	464	3.00	1.39	463	2.80	1.33	463	2.59	1.20	463	2.87	1.28	462	1.34	.57
	M	797	2.76	1.34	796	2.61	1.25	792	2.52	1.17	793	2.69	1.19	791	1.43	.62
	L	895	2.79	1.37	890	2.63	1.29	886	2.51	1.23	887	2.75	1.30	889	1.44	.62
		F=5.061, p<.01			F=3.545, p<.05			F=.750, p>.05			F-=2.971, p>.05			F=4.492, p<.05		
UC	H	464	3.26	1.51	463	2.90	1.39	462	2.58	1.26	462	2.52	1.17	462	1.48	.77
	M	796	2.94	1.49	795	2.83	1.37	791	2.53	1.23	791	2.51	1.17	793	1.35	.66
	L	895	3.03	1.54	889	2.95	1.41	885	2.69	1.33	885	2.65	1.27	889	1.26	.61
		F=6.649, p<.01			F=1.522, p>.05			F=3.603, p<.05			F=3.456, p<.05			F=17.075, p<.01		
RT	H	463	2.49	1.17	458	2.43	1.22	463	2.87	1.27	463	3.25	1.24	459	3.05	1.20
	M	797	2.65	1.18	794	2.50	1.15	792	2.82	1.22	793	3.12	1.21	786	3.10	1.16
	L	894	2.66	1.20	890	2.42	1.17	886	2.73	1.25	885	3.12	1.30	890	2.98	1.11
		F=3.200, p<.05			F=1.106, p>.05			F=2.205, p>.05			F=1.993, p>.05			F=2.231, p>.05		
TE	H	464	3.41	1.23	463	3.25	1.21	463	3.54	1.17	462	3.95	1.02	457	4.26	.88
	M	797	3.49	1.18	796	3.32	1.15	792	3.55	1.18	793	3.91	1.05	788	4.04	.95
	L	895	3.25	1.28	889	3.06	1.28	886	3.29	1.28	887	3.68	1.17	889	3.84	1.10
		F=8.640, p<.01			F=9.898, p<.01			F=11.296, p<.01			F=13.078, p<.01			F=27.014, p<.01		
IW	H	464	3.37	1.25	462	3.58	1.26	463	3.83	1.19	463	3.95	1.10	460	4.06	.79
	M	797	3.36	1.20	796	3.49	1.21	792	3.72	1.20	793	3.93	1.07	787	3.84	.90
	L	895	3.06	1.31	890	3.07	1.32	886	3.33	1.33	887	3.59	1.24	887	3.72	.94
		F=15.243, p<.01			F=33.081, p<.01			F=33.094, p<.01			F=23.355, p<.01			F=21.677, p<.01		
IH	H	464	2.99	1.33	463	3.40	1.33	462	3.67	1.31	463	4.14	1.09	459	3.25	1.11
	M	797	3.01	1.26	796	3.30	1.32	792	3.55	1.26	792	4.08	1.09	790	3.18	1.06
	L	895	2.92	1.37	890	3.14	1.39	886	3.38	1.40	887	3.92	1.21	885	2.96	1.10
		F=1.008, p>.05			F=5.871, p<.01			F=8.053, p<.01			F=7.106, p<.01			F=13.404, p<.01		
WD	H	464	2.63	1.20	463	2.49	1.19	463	2.50	1.15	463	2.57	1.21	455	1.88	.97
	M	797	2.61	1.22	796	2.51	1.16	792	2.46	1.12	793	2.53	1.11	787	1.92	.94
	L	895	2.46	1.22	890	2.42	1.21	885	2.33	1.15	887	2.48	1.16	886	1.80	.92
		F=4.590, p<.01			F=1.116, p>.05			F=4.586, p<.01			F=.938, p>.05			F=3.581, p<.05		
GD	H	464	2.85	1.31	463	2.70	1.27	463	2.63	1.17	463	2.68	1.21	458	1.45	.69
	M	797	2.74	1.26	796	2.68	1.25	792	2.60	1.18	792	2.62	1.14	784	1.57	.83
	L	895	2.69	1.34	889	2.67	1.31	883	2.54	1.24	887	2.59	1.22	882	1.54	.76
		F=2.107, p>.05			F=.074, p>.05			F=1.084, p>.05			F=.979, p>.05			F=3.411, p<.05		

7.2: the relationships between pupils' attribution styles and their perceived frequency of the teaching methods and affective attitudes promoted by the teaching methods

5th graders perceiving themselves successful in mathematics learning

Table 7.2.1: Mean scores and Standard Deviation of 5th graders' enjoyment promoted by teaching methods according to their attribution styles of success in mathematics learning

	Reading a textbook			Teacher explanation			Individual work		
	N	M	SD	N	M	SD	N	M	SD
Ability	32	2.88	1.24	32	2.72	1.44	32	3.50	1.55
Effort	364	3.05	1.14	363	3.49	1.17	364	3.01	1.20
Luck	93	2.61	1.16	93	2.98	1.15	93	2.59	1.17
Support form teacher	270	2.76	1.14	270	3.75	1.08	270	2.84	1.24
Home support	379	2.90	1.14	381	3.47	1.19	381	3.11	1.37
Task easiness	36	2.53	1.28	36	3.11	1.30	36	3.42	1.52
ANOVA	F=3.811, p=. 002			F=9.799, p=. 000			F=5.041, p=. 000		

Table 7.2.2: Mean scores and Standard Deviation of 5th graders' motivation to learn mathematics promoted by teaching methods according to their attribution styles of success in mathematics learning

	Reading a textbook			Teacher explanation			Individual work			Whole-class discussion		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Ability	32	2.66	1.29	32	2.72	1.33	32	3.78	1.36	32	2.78	1.36
Effort	363	3.03	1.22	364	3.40	1.18	364	3.22	1.31	364	3.35	1.14
Luck	93	2.58	1.18	93	2.53	1.14	93	2.83	1.32	93	2.96	1.24
Support form teacher	270	2.63	1.21	270	3.79	1.11	270	2.94	1.37	270	3.37	1.20
Home support	380	2.83	1.28	381	3.38	1.21	381	3.21	1.42	381	3.18	1.21
Task easiness	36	2.53	1.38	36	3.00	1.33	36	3.47	1.46	36	2.94	1.37
ANOVA	F=4.523, p=. 000			F=18.896, p=. 000			F=4.398, p=. 001			F=3.807, p=. 002		

Table 7.2.3: Mean scores and Standard Deviation of 5th graders' sense of security in learning mathematics promoted by teaching methods according to their attribution styles of success in mathematics learning

	Practical work			Teacher explanation			Individual work			Individual help			Group discussion		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
1	32	3.63	1.34	32	2.81	1.28	32	4.00	1.37	32	3.22	1.39	32	3.03	1.28
2	361	3.43	1.19	362	3.47	1.17	362	3.42	1.30	362	2.95	1.30	362	3.36	1.15
3	93	2.78	1.24	93	2.68	1.27	93	2.89	1.36	93	2.33	1.22	93	2.86	1.24
4	270	3.31	1.19	270	3.81	1.07	270	3.01	1.30	270	2.77	1.26	270	3.31	1.19
5	379	3.24	1.31	379	3.44	1.24	379	3.44	1.33	379	2.87	1.41	379	3.18	1.19
6	36	3.61	1.38	36	3.14	1.42	36	3.75	1.34	35	2.97	1.52	36	2.97	1.28
	F=5.014, p=. 000			F=15.153, p=. 000			F=8.332, p=. 000			F=3.985, p=. 001			F=3.638, p=. 003		

1=Ability, 2=Effort, 3=Luck, 4=Support from teacher, 5=Home support, 6=Task easiness

Table 7.2.4: Mean scores and Standard Deviation of 5th graders' sense of progress in learning mathematics promoted by teaching methods according to their attribution styles of success in mathematics learning

	Practical work			Teacher explanation			Individual work			Whole-class discussion		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Ability	32	3.56	1.46	32	3.53	1.41	32	3.94	1.24	32	3.41	1.39
Effort	363	3.62	1.20	364	3.91	1.07	364	3.68	1.20	364	3.60	1.14
Luck	93	3.19	1.26	93	3.35	1.21	93	3.33	1.30	93	3.17	1.30
Support form teacher	269	3.59	1.24	269	4.28	.85	269	3.38	1.26	269	3.58	1.21
Home support	378	3.35	1.31	379	3.90	1.14	379	3.65	1.31	379	3.34	1.24
Task easiness	36	3.67	1.33	36	3.64	1.38	36	3.67	1.39	36	3.19	1.41
ANOVA	F=3.175, p=. 007			F=12.180, p=. 000			F=3.335, p=. 005			F=3.603, p=. 003		

Table 7.2.5: Mean and Standard deviation of 5th graders' perceptions of frequency of deployment of teaching methods according to their attribution styles of success in mathematics learning

	Practical work			Individual work			Individual help			Group discussion		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Ability	31	2.23	.99	31	3.90	1.11	31	2.23	.96	30	2.33	.99
Effort	364	2.45	.87	360	3.66	.92	364	2.88	1.01	362	2.51	.89
Luck	93	2.40	.86	93	3.31	.97	92	2.64	1.01	93	2.38	.91
Support form teacher	268	2.60	1.00	267	3.47	.93	268	3.02	.89	267	2.58	1.01
Home support	381	2.42	.86	378	3.66	.89	380	2.74	1.02	378	2.39	.90
Task easiness	36	1.83	.94	36	3.81	.98	36	2.42	1.18	36	2.03	.77
ANOVA	F=5.390, p=. 000			F=4.486, p=. 000			F=6.983, p=. 000			F=3.454, p=. 004		

8th graders perceiving themselves successful in mathematics learning

Table 7.2.6: Mean scores and Standard Deviation of 8th graders' enjoyment promoted by teaching methods according to their attribution styles of success in mathematics learning

	Reading a textbook			Teacher explanation		
	N	M	SD	N	M	SD
Ability	58	2.41	1.31	58	2.86	1.33
Effort	412	2.74	1.19	412	3.58	1.15
Luck	159	2.41	1.08	160	3.23	1.25
Support form teacher	196	2.66	1.11	196	3.86	1.07
Home support	209	2.66	1.17	209	3.28	1.17
Task easiness	49	2.37	1.25	49	3.22	1.34
ANOVA	F=2.645, p<. 01			F=6.522, p<. 01		

Table 7.2.7: Mean scores and Standard Deviation of 8th graders' motivation to learn mathematics promoted by teaching methods according to their attribution styles of success in mathematics learning

	Reading a textbook			Teacher explanation		
	N	M	SD	N	M	SD
Ability	58	2.34	1.24	58	2.72	1.25
Effort	410	2.65	1.21	412	3.48	1.13
Luck	159	2.24	1.13	160	3.09	1.22
Support form teacher	196	2.64	1.13	196	3.71	1.01
Home support	207	2.49	1.17	208	3.08	1.18
Task easiness	49	2.06	.97	49	2.86	1.15
ANOVA	F=4.986, p=. 000			F=14.185, p=. 000		

Table 7.2.8: Mean scores and Standard Deviation of 8th graders' sense of security in learning mathematics promoted by teaching methods according to their attribution styles of success in mathematics learning

	Reading a textbook			Teacher explanation			Individual work		
	N	M	SD	N	M	SD	N	M	SD
Ability	58	2.88	1.35	58	3.21	1.39	58	4.03	1.20
Effort	409	3.02	1.24	409	3.71	1.11	409	3.95	1.17
Luck	160	2.56	1.17	160	3.18	1.23	160	3.49	1.28
Support form teacher	194	2.99	1.17	194	3.91	.98	194	3.58	1.09
Home support	208	2.79	1.23	208	3.37	1.20	208	3.72	1.12
Task easiness	49	2.63	1.33	49	3.29	1.41	49	3.82	1.30
ANOVA	F=4.217, p=. 001			F=11.278, p=. 000			F=5.484, p=. 000		

Table 7.2.9: Mean scores and Standard Deviation of 8th graders' sense of progress in learning mathematics promoted by teaching methods according to their attribution styles of success in mathematics learning

	Reading a textbook			Teacher explanation			Individual work		
	N	M	SD	N	M	SD	N	M	SD
Ability	58	3.21	1.40	58	3.69	1.20	58	3.97	1.06
Effort	409	3.31	1.24	408	4.08	.97	409	4.10	1.02
Luck	158	2.89	1.16	158	3.62	1.13	158	3.72	1.11
Support form teacher	196	3.29	1.20	196	4.19	.89	196	3.78	1.09
Home support	209	3.13	1.12	209	3.74	1.06	209	3.89	1.06
Task easiness	49	2.76	1.25	49	3.86	1.06	49	3.94	1.13
ANOVA	F=4.461, p=. 000			F=9.459, p=. 000			F=4.242, p=. 001		

Table 7.2.10: Mean scores and Standard Deviation of 8th graders' perceptions of frequency of deployment of teaching methods according to their attribution styles of success in mathematics learning

	Teacher explanation			Individual work			Individual help			Whole-class Discussion			Group Discussion		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
1	57	4.04	1.02	57	3.88	.96	57	3.18	1.30	57	1.82	1.04	57	1.35	.52
2	409	4.22	.84	409	4.05	.79	408	3.33	1.04	406	1.85	.88	409	1.54	.80
3	157	3.81	1.06	159	3.76	1.02	158	2.92	1.11	158	1.79	.90	157	1.46	.72
4	192	4.17	.87	193	3.84	.84	196	3.32	1.06	193	2.13	1.01	192	1.71	.93
5	207	4.06	.96	208	3.94	.82	208	3.09	1.06	206	1.97	.95	206	1.50	.69
6	49	4.27	1.00	49	3.86	1.12	48	2.90	1.19	49	1.61	1.04	49	1.37	.67
	F=5.151, p=.000			F=3.236, p=.007			F=5.089, p=.000			F=4.225, p=.001			F=3.365, p=.005		

1=Ability, 2=Effort, 3=Luck, 4=Support from teacher, 5=Home support, 6=Task easiness

5th graders perceiving themselves failing in mathematics learning

Table 7.2.11: Mean scores and Standard Deviation of 5th graders' perceived deployment of *Teacher explanation* and their affective attitudes towards mathematics learning promoted by this teaching method according to their attribution styles of failure in mathematics learning

Teacher explanation	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Lack of ability	88	2.93	1.28	88	2.77	1.32	88	2.75	1.38	88	3.08	1.44	87	2.93	1.19
Lack of effort	97	3.53	1.25	97	3.08	1.33	97	3.23	1.34	97	3.45	1.38	97	3.19	1.25
Lack of luck	9	3.33	1.80	9	3.11	1.76	9	3.67	1.66	9	4.11	1.36	9	4.11	.93
Lack of support form teacher	7	1.43	1.13	7	1.14	.38	7	1.29	.76	7	1.29	.76	7	2.14	1.07
Lack of home sup	10	2.50	1.51	10	2.50	1.18	10	2.30	1.42	10	2.80	1.32	10	3.40	1.27
Task difficulty	34	3.38	1.28	34	3.38	1.44	34	3.26	1.38	34	3.68	1.41	34	3.00	1.02
ANOVA	F= 5.317, p<. 01			F=4.016, p<. 01			F=4.535, p<. 01			F=4.984, p<. 01			F=2.842, p<. 05		

8th graders perceiving themselves failing in mathematics learning

Table 7.2.12: Mean scores and Standard Deviation of 8th graders' affective attitudes promoted by *Teacher explanation* and *Group discussion* according to their attribution styles of failure in mathematics learning

Teacher explanation	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Lack of ability	88	3.22	1.32	87	2.71	1.37	87	3.05	1.39	87	3.60	1.26	87	3.85	1.17
Lack of effort	487	3.35	1.22	485	3.22	1.21	482	3.41	1.20	482	3.82	1.06	485	3.93	1.05
Lack of luck	16	3.50	1.21	16	3.56	1.26	16	3.44	1.03	16	4.00	1.16	16	3.69	1.20
Lack of support fo teacher	55	2.65	1.42	54	2.48	1.30	55	2.93	1.41	55	3.07	1.29	55	3.73	1.06
Lack of home sup	24	3.38	1.31	24	3.17	1.37	24	3.38	1.31	24	3.71	1.08	24	3.96	.96
Task difficulty	58	3.21	1.28	58	3.28	1.25	58	3.36	1.29	58	3.93	1.01	58	3.64	1.12
ANOVA	F=1.512, p<1.0			F=2.293, p<. 01			F=1.257, p<1.0			F=2.470, p<. 01			F=1.277, p<. 5		

Group discussion	Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Lack of ability	88	2.72	1.39	87	2.83	1.46	87	2.67	1.44	87	2.53	1.27	87	1.51	.79
Lack of effort	487	2.72	1.29	484	2.69	1.24	480	2.60	1.21	482	2.72	1.19	482	1.56	.75
Lack of luck	16	2.63	1.26	16	2.44	1.41	16	2.25	1.13	16	2.50	1.16	16	1.44	.73
Lack of support form	55	2.55	1.39	55	2.55	1.36	55	2.31	1.25	**55**	**2.11**	**1.29**	55	1.35	.70
Lack of home suppo	24	3.08	1.35	24	2.71	1.20	24	2.88	1.19	24	2.79	.98	23	1.70	.64
Task difficulty	58	2.67	1.47	58	2.71	1.21	58	2.53	1.05	58	2.48	1.06	58	1.47	.68
ANOVA	F=1.092, p<. 5			F=. 775, p<1.0			F=1.327, p<. 5			F=2.039, p<. 01			F=1.297, p<. 5		

Table 7.3.1: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of satisfaction at 5th grade

satisfaction		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	640	3.47	1.28	640	3.49	1.27	638	3.40	1.22	637	3.56	1.26	638	2.51	.93
	L	744	3.15	1.36	744	3.09	1.36	740	3.02	1.35	742	3.24	1.33	743	2.33	.89
		t= 4.531, df=1382, p<.01			t=5.617, df=1382, p<.01			t=5.532, df=1376, p<.01			t=4.543, df=1377, p<.01			t= 3.764, df=1330.202, p<.01		
UC	H	639	3.16	1.56	638	3.25	1.50	637	3.00	1.45	634	3.05	1.33	637	1.60	.83
	L	744	3.44	1.56	744	3.40	1.49	741	3.16	1.47	741	3.15	1.41	742	1.50	.79
		t= -3.372, df=1381, p<.01			t=1.807, df=1380, p>.05			t= - 1.996, df=1376, p<.0			t=1.262, df=1359.017, p>.05			t= 2.151, df=1377, p<.05		
RT	H	640	3.07	1.15	638	3.03	1.27	637	3.24	1.28	637	3.66	1.25	635	3.46	.97
	L	740	2.65	1.15	743	2.56	1.24	739	2.73	1.31	742	3.24	1.38	743	3.35	.98
		t= 6.851, df=1347.908, p<			t=6.840, df=1379, p<.01			t=7.262, df=1374, p<.01			t=5.998, df=1372.244, p<			t=1.927, df=1376, p>.05		
TE	H	639	3.77	1.12	640	3.69	1.17	638	3.75	1.15	638	4.17	1.00	633	3.73	1.02
	L	744	3.11	1.23	744	2.99	1.26	740	3.05	1.28	743	3.55	1.28	740	3.50	1.06
		t=10.375, df=1381, p<.01			t=10.634, df=1382, p<.01			t=10.487, df=1376, p<.01			t=10.042, df=1366.493, p<.01			t= 4.048, df=1371, p<.01		
IW	H	640	3.20	1.31	640	3.32	1.36	638	3.46	1.31	638	3.71	1.25	633	3.59	.95
	L	744	2.66	1.29	744	2.78	1.38	741	2.94	1.40	743	3.27	1.37	739	3.39	1.04
		t=7.666, df=1382, p<.01			t=7.372, df=1382, p<.01			t=7.082, df=1377, p<.01			t=6.144, df=1373.414, p<			t= 3.605, df=1364.342, p<.01		
IH	H	637	2.54	1.25	639	2.79	1.34	638	2.88	1.36	638	3.33	1.36	637	2.92	1.02
	L	741	2.35	1.22	743	2.44	1.33	740	2.63	1.37	742	3.10	1.40	741	2.78	1.04
		t=2.926, df=1376, p<.01			t=4.917, df=1380, p<.01			t=3.383, df=1376, p<.01			t=3.044, df=1378, p<.01			t=2.412, df=1376, p<.05		
WD	H	640	3.42	1.16	640	3.40	1.21	638	3.44	1.19	638	3.57	1.19	629	3.42	1.04
	L	744	2.94	1.19	744	2.89	1.23	741	2.84	1.23	743	3.13	1.31	737	3.12	1.12
		t=7.628, df=1382, p<.01			t=7.754, df=1382, p<.01			t=9.098, df=1377, p<.01			t=6.433, df=1379, p<.01			t=5.119, df=1364, p<.01		
GD	H	640	3.28	1.18	640	3.31	1.18	638	3.35	1.18	636	3.43	1.18	634	2.52	.95
	L	744	2.98	1.23	744	2.93	1.24	741	2.89	1.22	743	3.06	1.25	737	2.31	.89
		t=4.603, df=1382, p<.01			t=5.847, df=1382, p<.01			t=7.143, df=1377, p<.01			t=5.652, df=1377, p<.01			t=4.352, df=1308.693, p<.01		

Table 7.3.2: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of satisfaction at 8^{th} grade

satisfaction		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	1138	2.82	1.35	1135	2.73	1.30	1131	2.60	1.23	1131	2.82	1.27	1129	1.48	.62
	L	843	2.83	1.37	841	2.58	1.26	840	2.44	1.15	839	2.65	1.22	840	1.34	.58
		t= -.184, df=1979, p>.05			t= 2.468, df=1974, p<.05			t= 3.022, df=1969, p<.01			t= 3.058, df=1968, p<.01			t= 5.146, df=1870.210, p<.01		
UC	H	1137	2.97	1.50	1133	2.83	1.36	1129	2.57	1.26	1129	2.52	1.19	1131	1.42	.73
	L	843	3.21	1.53	841	3.00	1.44	839	2.68	1.31	837	2.67	1.26	839	1.27	.60
		t=3.471, df=1791.387, p<.01			t= - 2.633, df=1972, p<.0			t= 1.924, df=1966, p>.05			t= - 2.731, df=1964, p<.01			t= 5.008, df=1944.876, p<.01		
RT	H	1138	2.74	1.20	1131	2.59	1.20	1132	2.92	1.24	1131	3.32	1.24	1129	3.11	1.12
	L	842	2.43	1.15	838	2.27	1.12	839	2.62	1.23	837	2.94	1.24	833	2.93	1.19
		t= 5.870, df=1978, p<.01			t= 6.012, df=1863.504, p<.01			t= 5.286, df=1808.626, p<.01			t= 6.791, df=1966, p<.01			t= 3.391, df=1960, p<.01		
TE	H	1138	3.66	1.13	1135	3.48	1.16	1131	3.68	1.14	1131	4.03	1.00	1126	4.06	.98
	L	843	3.01	1.27	840	2.81	1.20	840	3.13	1.27	838	3.58	1.16	836	3.97	1.03
		t= 12.058, df=1979, p<.01			t= 12.540, df=1973, p<.01			t= 9.882, df=1695.996, p			t= 8.884, df=1642.743, p<.01			t= 1.831, df=1960, p>.05		
IW	H	1138	3.42	1.22	1135	3.51	1.26	1131	3.72	1.22	1131	3.93	1.11	1126	3.86	.87
	L	843	2.99	1.28	840	3.13	1.27	840	3.42	1.31	839	3.63	1.20	836	3.83	.93
		t= 7.465, df=1979, p<.01			t= 6.525, df=1973, p<.01			t= 5.254, df=1733.318, p<.01			t= 5.831, df=1728.853, p<.01			t= .785, df=1735.678, p>.		
IH	H	1138	3.11	1.29	1135	3.39	1.33	1130	3.63	1.29	1131	4.11	1.10	1125	3.29	1.07
	L	843	2.81	1.33	841	3.11	1.36	840	3.37	1.35	838	3.94	1.20	837	2.88	1.09
		t=-5.057, df=1782.607, p<.01			t= 4.641, df=1974, p<.01			t= 4.244, df=1968, p<.01			t= 3.224, df=1708.718, p<.01			t= 8.217, df=1960, p<.01		
WD	H	1138	2.63	1.22	1135	2.58	1.19	1130	2.52	1.13	1131	2.63	1.15	1123	1.99	.99
	L	843	2.42	1.19	841	2.32	1.17	840	2.27	1.14	839	2.37	1.14	833	1.69	.84
		t=-3.758, df=1979, p<.01			t= 4.823, df=1974, p<.01			t= 4.802, df=1968, p<.01			t= 5.121, df=1968, p<.01			t= 7.160, df=1954, p<.01		
GD	H	1138	2.77	1.28	1134	2.78	1.26	1130	2.66	1.20	1130	2.70	1.16	1121	1.62	.83
	L	843	2.72	1.34	841	2.56	1.29	838	2.48	1.20	839	2.52	1.20	830	1.42	.69
		t= .833, df=1770.113, p>.05			t= 3.757, df=1973, p<.01			t= 3.414, df=1966, p<.01			t= 3.486, df=1771.332, p<.01			t= 5.760, p=1916.946, p<.01		

Table 7.3.3: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of cohesiveness at 5^{th} grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	733	3.50	1.28	733	3.48	1.25	730	3.44	1.21	732	3.58	1.23	731	2.53	.90
	L	644	3.07	1.36	644	3.02	1.39	641	2.91	1.35	640	3.17	1.38	644	2.31	.93
		T=6.055, df=1375, p<.01			t=6.428, df=1375, p<.01			t=7.613, df=1297.834, p<			t=5.859, df=1288.573, p<			t=4.333, df=1373, p<.01		
UC	H	733	3.32	1.53	732	3.35	1.47	730	3.09	1.43	731	3.09	1.33	729	1.65	.86
	L	643	3.32	1.61	643	3.31	1.52	641	3.09	1.50	638	3.11	1.43	644	1.44	.73
		t=.009, df=1331.388, p>.(			t=.459, df=1373, p>.05			t=.051, df=1369, p>.05			t=.160, df=1308.835, p>.05			t=4.871, df=1368.696, p<.01		
RT	H	732	3.03	1.15	730	2.94	1.26	728	3.15	1.31	730	3.60	1.28	729	3.48	.95
	L	641	2.64	1.17	644	2.59	1.27	641	2.77	1.31	641	3.24	1.40	643	3.31	.98
		t=6.066, df=1342.152, p<			t=5.048, df=1372, p<.01			t=5.334, df=1367, p<.01			t=4.969, df=1307.583, p<			t=3.313, df=1370, p<.01		
TE	H	733	3.68	1.12	733	3.57	1.16	730	3.60	1.18	732	4.05	1.05	726	3.74	1.01
	L	643	3.13	1.28	644	3.01	1.32	641	3.12	1.33	642	3.59	1.31	641	3.47	1.06
		t=8.298, df=1287.336, p<			t=8.296, df=1375, p<.01			t=7.142, df=1290.717, p<			t=7.185, df=1226.260, p<			t=4.797, df=1324.882, p<.01		
IW	H	733	2.98	1.30	733	3.10	1.39	730	3.27	1.35	732	3.56	1.28	725	3.54	.95
	L	644	2.83	1.34	644	2.93	1.41	642	3.07	1.42	642	3.36	1.38	641	3.40	1.05
		t=2.190, df=1375, p<.05			t=2.201, df=1375, p<.05			t=2.749, df=1370, p<.01			t=2.751, df=1316.639, p<			t=2.454, df=1301.617, p<		
IH	H	733	2.51	1.25	733	2.70	1.31	730	2.83	1.36	731	3.25	1.34	729	2.98	1.02
	L	639	2.35	1.23	643	2.47	1.36	642	2.62	1.38	642	3.14	1.44	643	2.68	1.02
		t=2.452, df=1370, p<.05			t=3.277, df=1374, p<.01			t=2.850, df=1370, p<.01			t=1.575, df=1316.406, p>			t=5.417, df=1349.042, p<.01		
WD	H	733	3.40	1.14	733	3.40	1.15	730	3.42	1.18	732	3.62	1.15	722	3.40	1.04
	L	644	2.91	1.22	644	2.82	1.28	642	2.78	1.25	642	3.02	1.32	638	3.12	1.14
		t=7.790, df=1375, p<.01			t=8.714, df=1375, p<.01			t=9.603, df=1370, p<.01			t=8.911, df=1280.977, p<			t=4.744, df=1358, p<.01		
GD	H	733	3.34	1.16	733	3.37	1.14	730	3.37	1.12	731	3.43	1.15	726	2.54	.95
	L	644	2.88	1.24	644	2.82	1.28	642	2.82	1.27	641	3.01	1.28	639	2.28	.90
		t=7.154, df=1375, p<.01			t=8.286, df=1298.324, p<			t=8.476, df=1290.187, p<			t=6.409, df=1370, p<.01			t=5.152, df=1355.421, p<.01		

Table 7.3.4: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of cohesiveness at 8^{th} grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	990	2.93	1.36	988	2.84	1.28	987	2.66	1.19	985	2.86	1.21	983	1.46	.62
	L	971	2.74	1.37	968	2.51	1.28	966	2.43	1.20	967	2.65	1.29	966	1.37	.58
		t=3.083, df=1959, p<.01			t=5.671, df=1954, p<.01			t=4.182, df=1951, p<.01			t=3.635, df=1936.861, p<			t=3.524, df=1941.932, p<.01		
UC	H	989	3.11	1.51	986	2.98	1.38	984	2.68	1.28	983	2.62	1.20	984	1.37	.68
	L	971	3.04	1.51	968	2.83	1.41	966	2.54	1.27	965	2.54	1.23	966	1.34	.68
		t=1.074, df=1958, p>.05			t=2.349, df=1952, p<.05			t=2.307, df=1948, p<.05			t=1.482, df=1946, p>.05			t=.918, df=1948, p>.05		
RT	H	989	2.69	1.16	983	2.57	1.18	988	2.91	1.21	985	3.29	1.22	982	3.15	1.12
	L	971	2.53	1.20	966	2.34	1.16	965	2.69	1.27	965	3.04	1.27	960	2.92	1.17
		t=2.983, df=1958, p<.01			t=4.478, df=1947, p<.01			t=3.941, df=1941.558, p<.01			t=4.331, df=1948, p<.01			t=4.289, df=1940, p<.01		
TE	H	990	3.53	1.18	988	3.36	1.17	987	3.62	1.17	984	3.99	1.01	980	4.11	.93
	L	971	3.25	1.27	967	3.04	1.25	966	3.28	1.25	967	3.72	1.14	963	3.94	1.06
		t=5.077, df=1959, p<.01			t=5.870, df=1953, p<.01			t=6.130, df=1951, p<.01			t=5.477, df=1912.829, p<.01			t=3.811, df=1899.450, p<		
IW	H	990	3.30	1.23	987	3.42	1.26	987	3.71	1.21	985	3.89	1.13	980	3.86	.88
	L	971	3.16	1.30	968	3.26	1.30	966	3.48	1.31	966	3.72	1.18	962	3.83	.92
		t=2.566, df=1959, p<.05			t=2.691, df=1953, p<.01			t=4.153, df=1933.090, p<.01			t=3.332, df=1942.514, p<			t=.626, df=1940, p>.05		
IH	H	990	3.07	1.27	988	3.38	1.31	986	3.65	1.27	984	4.13	1.07	982	3.27	1.05
	L	971	2.90	1.34	968	3.17	1.39	966	3.40	1.36	967	3.96	1.20	959	2.97	1.11
		t=2.772, df=1950.528, p<			t=3.363, df=1954, p<.01			t=4.097, df=1934.164, p<.01			t=3.307, df=1918.763, p<.01			t=5.935, df=1939, p<.01		
WD	H	990	2.71	1.23	988	2.67	1.20	986	2.57	1.15	985	2.65	1.14	978	1.97	.99
	L	971	2.38	1.17	968	2.27	1.14	966	2.25	1.11	967	2.40	1.16	958	1.77	.87
		t=6.075, df=1959, p<.01			t=7.536, df=1954, p<.01			t=6.259, df=1950, p<.01			t=4.846, df=1947.125, p<			t=4.517, df=1934, p<.01		
GD	H	990	2.90	1.29	987	2.89	1.27	985	2.76	1.19	985	2.74	1.15	974	1.59	.81
	L	971	2.59	1.30	968	2.48	1.24	965	2.41	1.18	966	2.51	1.20	957	1.48	.74
		t=5.195, df=1957.151, p<.01			t=7.253, df=1953, p<.01			t=6.515, df=1948, p<.01			t=4.450, df=1939.784, p<.01			t=3.331, df=1918.195, p<		

Table 7.3.5: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of difficulty at 5th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	567	3.18	1.34	567	3.10	1.35	563	3.04	1.33	565	3.23	1.38	566	2.36	.90
	L	829	3.38	1.33	829	3.38	1.32	827	3.30	1.27	826	3.48	1.27	827	2.47	.93
		t= - 2.850, df=1394, p<.01			t= -3.814, df=1394, p<.01			t= - 3.653, df=1388, p<.01			t= - 3.431, df=1143.665, p<.01			t= - 2.276, df=1391, p<.05		
UC	H	567	3.31	1.59	567	3.30	1.51	564	3.04	1.49	562	3.06	1.44	565	1.52	.81
	L	828	3.31	1.55	827	3.35	1.49	826	3.13	1.44	825	3.15	1.33	826	1.57	.81
		t=.013, df=1393, p>.05			t= - .587, df=1392, p>.05			t= - 1.038, df=1388, p>.05			t= - 1.114, df=1140.054, p>.05			t= - 1.326, df = 1389, p>.05		
RT	H	563	2.73	1.17	566	2.63	1.28	562	2.80	1.35	564	3.21	1.41	565	3.30	.97
	L	829	2.93	1.17	827	2.87	1.27	826	3.08	1.29	826	3.59	1.28	825	3.48	.97
		t= - 2.996, df=1390, p<.01			t= - 3.422, df=1391, p<.01			t= - 3.945, df=1163.752, p<.01			t= - 5.143, df=1128.599, p<.01			t= - 3.404, df=1388, p<.01		
TE	H	567	3.24	1.28	567	3.12	1.32	564	3.18	1.34	565	3.62	1.32	564	3.50	1.11
	L	828	3.54	1.18	829	3.43	1.21	826	3.50	1.20	828	3.97	1.09	820	3.68	1.00
		t= - 4.595, df=1393, p<.01			t= - 4.424, df=1394, p<.01			t= - 4.600, df=1115.701, p<.01			t= - 5.241, df=1052.460, p<.01			t= - 3.077, df=1131.882, p<.01		
IW	H	567	2.72	1.35	567	2.84	1.44	564	2.92	1.45	565	3.30	1.43	564	3.30	1.05
	L	829	3.04	1.29	829	3.16	1.36	827	3.36	1.31	828	3.59	1.25	820	3.61	.95
		t= - 4.368, df=1181.214, p<.01			t= - 4.207, df=1170.143, p<.01			t= - 5.698, df=1125.321, p<.01			t= - 3.827, df=1100.742, p<.01			t= - 5.653, df=1126.489, p<.01		
IH	H	566	2.35	1.25	567	2.50	1.35	564	2.62	1.43	564	3.06	1.43	565	2.82	1.01
	L	824	2.49	1.23	827	2.67	1.33	826	2.82	1.32	828	3.30	1.35	825	2.84	1.04
		t= - 2.066, df=1388, p<.05			t= - 2.295, df=1392, p<.05			t= - 2.594, df=1146.261, p<.05			t= - 3.157, df= 1390, p<.01			t= - .335, df=1388, p>.05		
WD	H	567	2.98	1.25	567	2.91	1.28	564	2.96	1.31	565	3.14	1.33	559	3.14	1.11
	L	829	3.28	1.15	829	3.27	1.21	827	3.22	1.20	828	3.46	1.22	818	3.34	1.08
		t= - 4.678, df = 1394, p<.01			t= - 5.417, df=1394, p<.01			t= - 3.817, df=1389, p<.01			t= - 4.672, df=1391, p<.01			t= - 3.296, df=1375, p<.01		
GD	H	567	3.01	1.25	567	2.96	1.25	564	2.97	1.24	565	3.06	1.29	561	2.35	.92
	L	829	3.21	1.20	829	3.20	1.21	827	3.20	1.20	826	3.34	1.17	822	2.47	.94
		t= - 3.013, df=1394, p<.01			t= - 3.624, df=1394, p<.01			t= - 3.495, df=1389, p<.01			t= - 4.156, df=1389, p<.01			t= - 2.178, df=1381, p<.05		

Table 7.3.6: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of difficulty at 8th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	992	2.85	1.37	988	2.68	1.28	987	2.53	1.20	988	2.78	1.26	984	1.45	.64
	L	991	2.81	1.35	989	2.66	1.29	986	2.55	1.20	984	2.74	1.24	987	1.40	.57
		t= .647, df=1981, p>.05			t = .449, df=1975, p>.05			t= -.386, df=1971, p>.05			t= .647, df=1970, p>.05			t=1.826, df=1941.552, p>.05		
UC	H	992	3.11	1.54	988	2.96	1.41	987	2.68	1.31	986	2.63	1.24	985	1.32	.65
	L	991	3.03	1.48	988	2.86	1.37	984	2.56	1.24	983	2.55	1.20	987	1.39	.70
		t= 1.114, df=1978.654, p>			t= 1.551, df=1974, p>.05			t =2.174, df=1969, p<.05			t= 1.574, df=1967, p>.05			t= - 2.002, df=1961.642, p<.05		
RT	H	992	2.53	1.17	986	2.36	1.17	986	2.68	1.22	986	3.06	1.27	982	2.96	1.13
	L	990	2.71	1.20	984	2.56	1.18	987	2.91	1.25	984	3.25	1.23	983	3.12	1.16
		t= - 3.422, df=1980, p<.01			t = - 3.680, df=1968, p<.01			t= - 4.220, df=1971, p<.01			t= - 3.321, df=1968, p<.01			t = - 3.162, df=1961.695, p<.01		
TE	H	992	3.30	1.26	987	3.11	1.24	987	3.34	1.23	988	3.75	1.14	980	3.93	1.05
	L	991	3.46	1.21	989	3.29	1.19	986	3.53	1.21	983	3.92	1.04	985	4.12	.95
		t = - 2.826, df=1981, p<.01			t = - 3.417, df=1974, p<.0			t= - 3.492, df=1971, p<.0			t= - 3.387, df=1953.735, p<..01			t= - 4.181, df=1941.754, p<.01		
IW	H	992	3.08	1.28	988	3.17	1.31	987	3.45	1.31	988	3.66	1.23	983	3.79	.95
	L	991	3.39	1.23	988	3.51	1.23	986	3.76	1.20	984	3.94	1.07	981	3.91	.84
		t= - 5.460, df=1981, p<.01			t = - 5.971, df=1974, p<.0			t= - 5.436, df=1957.264, p<.01			t= - 5.322, df=1937.660, p<.01			t= - 3.037, df=1930.491, p<.01		
IH	H	992	2.96	1.36	988	3.25	1.40	987	3.52	1.33	987	4.02	1.17	980	3.10	1.11
	L	991	2.99	1.27	989	3.28	1.31	985	3.51	1.32	984	4.04	1.13	985	3.13	1.08
		t= - .393, df=1972.636, p>.05			t = - .361, df= 1965.965, p>.05			t= .135, df=1970, p>.05			t= - .432, df=1969, p>.05			t= - .626, df=1963, p>.05		
WD	H	992	2.55	1.21	988	2.49	1.18	987	2.42	1.15	988	2.48	1.15	981	1.86	.94
	L	991	2.54	1.20	989	2.45	1.18	985	2.42	1.12	984	2.56	1.15	977	1.88	.94
		t= .194, df=1981, p>.05			t = .695, df=1975, p>.05			t= .003, df=1970. p>.05			t= - 1.527, df=1970, p>.05			t= -.325, df=1956, p>.05		
GD	H	992	2.77	1.33	988	2.75	1.30	985	2.60	1.22	987	2.62	1.19	975	1.56	.79
	L	991	2.71	1.27	988	2.62	1.24	985	2.56	1.17	984	2.63	1.16	978	1.51	.75
		t= 1.091, df=1981, p>.05			t = 2.306, df=1974, p<.05			t= .773, df=1968, p>.05			t= - .074, df=1969, p>.05			t= 1.658, df=1951, p>.05		

Table 7.3.7: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of friction at 5th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	668	3.24	1.32	668	3.20	1.34	666	3.10	1.34	666	3.33	1.33	666	2.37	.89
	L	723	3.35	1.35	723	3.34	1.34	719	3.27	1.27	720	3.44	1.30	722	2.46	.93
		T= - 1.617, df=1389, p>.05			t= - 1.946, df=1389, p>.05			t= - 2.518, df=1383, p<.05			T= - 1.497, df=1384, p>.05			t= - 1.695, df=1386, p>.05		
UC	H	668	3.40	1.58	668	3.40	1.52	666	3.17	1.50	665	3.21	1.42	664	1.49	.79
	L	722	3.22	1.54	721	3.26	1.48	719	3.00	1.42	717	3.00	1.32	722	1.61	.83
		t= 2.071, df=1388, p<.05			t= 1.781, df=1387, p>.05			t= 2.232, df=1360.947, p<.05			t= 2.904, df=1348.735, p<.01			t= - 2.696, df=1382.105, p<.05		
RT	H	665	2.75	1.16	666	2.70	1.29	663	2.92	1.37	664	3.31	1.40	664	3.33	.96
	L	722	2.94	1.18	722	2.85	1.26	720	3.00	1.29	721	3.53	1.29	721	3.46	.97
		t= - 3.005, df=1385, p<.01			t= - 2.203, df=1386, p<.05			t= - 1.098, Df=1353.497, p>.05			t= - 3.067, df=1346.995, p<.01			t= - 2.509, df=1383, p<.05		
TE	H	667	3.26	1.25	668	3.17	1.32	666	3.29	1.32	666	3.73	1.27	662	3.57	1.05
	L	723	3.56	1.20	723	3.43	1.20	719	3.45	1.21	720	3.92	1.12	717	3.65	1.04
		t= - 4.583, df=1388, p<.01			t= - 3.948, df=1348.668, p<.01			t= - 2.315, df=1346.944, p<.05			t - 2.958, df=1331.515, p<.01			t= - 1.402, df=1377, p>.05		
IW	H	668	2.90	1.35	668	2.98	1.43	666	3.11	1.41	666	3.45	1.38	663	3.46	1.00
	L	723	2.92	1.30	723	3.07	1.37	720	3.24	1.36	722	3.49	1.28	717	3.49	1.01
		t= - .340, df=1368.444, p>.05			t= - 1.214, df=1368.479, p>.05			t= - 1.850, df=1384, p>.05			T= - .559, Df=1352.766, p>.05			t= -.566, df=1378, p>.05		
IH	H	666	2.41	1.24	668	2.55	1.38	666	2.71	1.39	666	3.14	1.43	664	2.83	1.07
	L	720	2.46	1.22	721	2.65	1.32	719	2.78	1.36	722	3.26	1.34	721	2.85	1.00
		t= - .754, df=1384, p>.05			t= - 1.318, df=1387, p>.05			t= - .949, df=1383, p>.05			T= - 1.539, Df=1357.619, p>.05			t= - .421, df=1383, p>.05		
WD	H	668	3.06	1.21	668	2.99	1.26	666	2.95	1.25	666	3.14	1.27	657	3.23	1.08
	L	723	3.24	1.19	723	3.24	1.23	720	3.24	1.24	722	3.50	1.26	716	3.30	1.10
		t= - 2.940, df=1389, p<.01			t= - 3.778, df=1389, p<.01			t= - 4.221, df=1384, p<.01			t= - 5.215, df=1386, p<.01			t= - 1.193, df=1371, p>.0		
GD	H	668	3.00	1.24	668	2.98	1.26	666	2.96	1.23	666	3.10	1.23	660	2.35	.95
	L	723	3.23	1.20	723	3.21	1.20	720	3.22	1.20	720	3.33	1.22	717	2.47	.91
		t= - 3.587, df=1389, p<.01			t= - 3.513, df=1389, p<.01			t= - 3.983, df=1384, p<.01			t= - 3.492, df=1384, p<.01			t= - 2.329, df=1375, p<.0		

Table 7.3.8: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of friction at 8th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	625	2.74	1.39	624	2.65	1.32	623	2.52	1.22	622	2.77	1.31	620	1.42	.60
	L	1360	2.87	1.35	1355	2.68	1.27	1352	2.55	1.19	1352	2.74	1.22	1353	1.42	.61
		t= - 1.869, df=1983, p>.05			t= - .532, df=1977, p>.05			t= - .539, df=1973, p>.05			t=.507, df=1133.069, p>.05			t= .199, df=1971, p>.05		
UC	H	625	3.01	1.53	624	2.94	1.38	623	2.63	1.29	620	2.65	1.27	622	1.31	.64
	L	1359	3.10	1.50	1353	2.90	1.40	1349	2.61	1.27	1350	2.56	1.20	1352	1.38	.70
		t= - 1.236, df=1982, p>.0			t= .592, df=1975, p>.05			t= .446, df=1970, p>.05			t= 1.451, df=1968, p>.05			t= - 2.283, df=1304.205, p<.05		
RT	H	624	2.52	1.21	623	2.36	1.23	623	2.72	1.28	622	3.13	1.28	622	2.97	1.14
	L	1360	2.66	1.18	1349	2.50	1.15	1352	2.83	1.22	1350	3.17	1.24	1345	3.07	1.16
		t= -2.299, df=1982, p<.05			t= - 2.360, df=1144.724, p<.05			t= - 1.719, df=1157.412, p>.05			t= - .723, df=1970, p>.05			t= - 1.687, df=1965, p>.05		
TE	H	625	3.32	1.30	624	3.11	1.29	623	3.39	1.27	622	3.75	1.20	617	3.86	1.09
	L	1360	3.41	1.21	1354	3.24	1.19	1352	3.47	1.20	1351	3.88	1.04	1349	4.10	.95
		t= - 1.407, df=1136.819, p>.05			t= - 2.051, df=1126.089, p<.05			t= - 1.385, df=1973, p>.05			t= - 2.274, Df=1063.877, p<.05			t= - 4.696, df=1066.660, p<.01		
IW	H	625	3.16	1.30	624	3.24	1.32	623	3.48	1.34	622	3.77	1.22	617	3.78	.98
	L	1360	3.26	1.25	1354	3.39	1.26	1352	3.64	1.23	1352	3.82	1.13	1349	3.87	.85
		t= - 1.640, df=1983, p>.05			t= - 2.351, df=1976, p<.0			t= - 2.522, df=1117.788, p<.05			t= - .935, df=1125.098, p>.05			t= - 1.889, df=1056.133, p>.05		
IH	H	625	2.99	1.37	624	3.30	1.44	623	3.53	1.38	621	4.03	1.19	618	3.16	1.12
	L	1360	2.98	1.29	1355	3.26	1.31	1351	3.52	1.30	1352	4.04	1.13	1348	3.10	1.08
		t= .226, df=1143.969, p>.			t= .611, df=1117.035, p>.05			t= .131, df=1147.686, p>.			t= - .266, df=1971, p>.05			t= 1.159, df=1964, p>.05		
WD	H	625	2.48	1.25	624	2.44	1.22	623	2.38	1.18	622	2.50	1.20	615	1.90	.98
	L	1360	2.58	1.19	1355	2.49	1.17	1351	2.44	1.12	1352	2.53	1.13	1345	1.86	.93
		t= - 1.640, df=1157.819, p>.05			t= - .834, df=1977, p>.05			t= - 1.007, df=1972, p>.05			t= - .556, df=1138.228, p			t= 1.018, df=1958, p>.05		
GD	H	625	2.64	1.34	624	2.65	1.32	622	2.55	1.25	621	2.61	1.23	610	1.57	.77
	L	1360	2.80	1.28	1354	2.71	1.25	1350	2.60	1.18	1352	2.63	1.16	1345	1.52	.78
		t= - 2.464, df=1160.797, p<.05			t= - .994, df=1152.504, p>.05			t= - .922, df=1145.864, p>.05			t= - .459, df=1139.793, p>.05			t= 1.296, df=1953, p>.05		

Table 7.3.9: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of perceived competitiveness at 5th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	724	3.35	1.31	724	3.30	1.33	722	3.25	1.31	723	3.42	1.31	723	2.42	.87
	L	665	3.23	1.37	665	3.23	1.35	661	3.13	1.30	661	3.36	1.33	663	2.42	.96
		T= 1.620, df=1387, p>.05			t= .927, df=1387, p>.05			t= 1.637, df=1381, p>.05			t= .834, df=1382, p>.05			t= .026, df=1339.486, p>.05		
UC	H	724	3.44	1.56	723	3.47	1.47	722	3.23	1.45	720	3.23	1.40	722	1.61	.87
	L	664	3.18	1.55	664	3.18	1.50	661	2.94	1.46	660	2.98	1.33	662	1.49	.74
		t= 3.050, df=1386, p<.01			t= 3.584, df=1385, p<.01			t= 3.628, df=1381, p<.01			t= 3.442, df=1375.887, p<.01			t= 2.675, df = 1374.063, p<.01		
RT	H	723	2.89	1.17	723	2.79	1.27	721	3.00	1.35	722	3.41	1.37	722	3.40	.98
	L	662	2.81	1.18	663	2.77	1.29	660	2.93	1.30	661	3.44	1.32	661	3.39	.95
		t=1.240, df=1383, p>.05			t= .254, df=1384, p>.05			t= 1.034, df=1379, p>.05			t= -.400, df=1381, p>.05			t= .051, df=1381, p>.05		
TE	H	724	3.41	1.26	724	3.28	1.28	722	3.41	1.31	723	3.85	1.18	718	3.64	1.04
	L	664	3.44	1.20	665	3.34	1.25	661	3.34	1.23	663	3.81	1.22	659	3.57	1.06
		t= - .450, df=1386, p>.05			t= -.892, df=1387, p>.05			t= .973, df=1379.915, p>.05			t= .672, df=1384, p>.05			t= 1.139, df=1375, p>.05		
IW	H	724	2.98	1.34	724	3.08	1.42	722	3.29	1.39	723	3.59	1.31	721	3.58	.99
	L	665	2.83	1.30	665	2.96	1.38	662	3.06	1.37	663	3.33	1.35	656	3.36	1.01
		t= 2.138, df=1387, p<.05			t=1.623, df=1387, p>.05			t= 3.102, df=1382, p<.01			t= 3.653, df=1384, p<.01			t= 4.138, df=1375, p<.01		
IH	H	722	2.46	1.24	724	2.62	1.35	722	2.82	1.38	722	3.27	1.36	721	2.77	1.03
	L	661	2.40	1.22	663	2.58	1.33	661	2.66	1.36	663	3.13	1.43	662	2.92	1.03
		t= .845, df=1381, p>.05			t= .648, df=1385, p>.05			t= 2.098, df=1381, p<.05			t=1.957, df=1383, p>.05			t= - 2.816, df=1381, p<.01		
WD	H	724	3.13	1.18	724	3.09	1.24	722	3.04	1.24	723	3.30	1.26	715	3.26	1.11
	L	665	3.18	1.24	665	3.14	1.27	662	3.18	1.27	663	3.35	1.29	655	3.25	1.08
		t= - . 759, df=1362.801, p>.05			t= -.771, df=1387, p>.05			t= - 2.093, df=1382, p<.05			t= - .852, df=1384, p>.05			t= .160, df=1368, p>.05		
GD	H	724	3.08	1.24	724	3.08	1.24	722	3.09	1.21	723	3.19	1.22	719	2.38	.89
	L	665	3.16	1.21	665	3.11	1.23	662	3.10	1.24	661	3.26	1.25	656	2.46	.98
		t= - 1.245, df=1387, p>.05			t= -.472, df=1387, p>.05			t= - .084, df=1382, p>.05			t= - 1.063, df=1382, p>.05			t= - 1.564, df=1327.380, p>.05		

Table 7.3.10: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils with higher and lower levels of perceived competitiveness at 8th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	896	2.86	1.41	895	2.71	1.34	896	2.56	1.21	894	2.81	1.27	894	1.43	.62
	L	1082	2.80	1.33	1077	2.64	1.24	1072	2.52	1.20	1073	2.72	1.24	1072	1.40	.60
		t= 1.031, df=1862.934, p>.05			t=1.177, df=1848.257, p>.05			t=.632, df=1966, p>.05			t= 1.643, df=1965, p>.05			t= 1.057, df=1964, p>.05		
UC	H	896	3.04	1.53	894	2.88	1.41	895	2.57	1.29	892	2.57	1.24	895	1.41	.72
	L	1081	3.10	1.50	1076	2.93	1.38	1070	2.65	1.27	1071	2.60	1.21	1072	1.31	.65
		t= -.771, df=1975, p>.05			t= -.869, df=1968, p>.05			t= -1.406, df=1963, p>.05			t= -.672, df=1961, p>.05			t=3.482, df=1809.978, p<.01		
RT	H	895	2.65	1.21	892	2.49	1.21	896	2.89	1.27	894	3.28	1.24	889	3.10	1.13
	L	1082	2.58	1.17	1073	2.42	1.16	1072	2.71	1.22	1071	3.06	1.26	1070	2.98	1.16
		t=1.202, df=1975, p>.05			t=1.211, df=1963, p>.05			t=3.104, df=1966, p<.01			t= 3.969, df=1963, p<.01			t=2.363, df=1957, p<.05		
TE	H	896	3.46	1.25	895	3.29	1.24	896	3.58	1.19	894	3.93	1.10	889	4.08	.97
	L	1082	3.32	1.23	1076	3.13	1.21	1072	3.33	1.24	1072	3.77	1.08	1070	3.99	1.03
		t=2.365, df=1976, p<.05			t=2.877, df=1886.556, p<.01			t=4.510, df=1966, p<.01			t=3.208, df=1964, p<.01			t= 1.950, df=1957, p>.05		
IW	H	896	3.31	1.28	894	3.44	1.28	896	3.69	1.26	894	3.87	1.14	887	3.89	.90
	L	1082	3.18	1.25	1077	3.27	1.28	1072	3.53	1.26	1073	3.75	1.17	1072	3.82	.89
		t=2.178, df=1976, p<.05			t=2.896, df=1969, p<.01			t=2.736, df=1966, p<.01			t=2.251, df=1965, p<.05			t= 1.516, df=1957, p>.05		
IH	H	896	3.05	1.32	895	3.38	1.37	896	3.67	1.29	893	4.12	1.11	890	3.21	1.08
	L	1082	2.92	1.31	1077	3.18	1.33	1071	3.40	1.34	1073	3.97	1.18	1068	3.05	1.10
		t=2.261, df=1976, p<.05			t=3.142, df=1884.085, p<.01			t=4.495, df=1928.259, p<.01			t=2.905, df=1964, p<.01			t=3.209, df=1956, p<.01		
WD	H	896	2.60	1.25	895	2.52	1.23	895	2.46	1.15	894	2.55	1.18	885	1.93	.97
	L	1082	2.50	1.18	1077	2.43	1.15	1072	2.38	1.13	1073	2.51	1.13	1069	1.82	.91
		t= 1.755, df=1863.432, p>.05			t=1.720, df=1848.127, p>.05			t=1.523, df=1965, p>.05			t=.930, df=1965, p>.05			t= 2.545, df=1952, p<.05		
GD	H	896	2.73	1.30	894	2.69	1.29	893	2.60	1.21	894	2.64	1.19	880	1.56	.77
	L	1082	2.75	1.31	1077	2.67	1.26	1072	2.57	1.19	1072	2.62	1.17	1068	1.51	.77
		t= -.338, df=1976, p>.05			t=.353, df=1969, p>.05			t=.597, df=1963, p>.05			t= .228, df=1964, p>.05			t= 1.595, df=1946, p>.05		

Table 7.4.1: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils perceiving their teachers praising them because of better achievement than others with lower frequency and higher frequency at 5th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	600	3.42	1.28	600	3.40	1.27	595	3.32	1.25	599	3.54	1.29	600	2.52	.92
	L	865	3.21	1.36	865	3.17	1.37	864	3.10	1.33	862	3.28	1.32	863	2.33	.91
		t=2.893, df=1463, p<.01			t=3.156, df=1463, p<.01			t=3.229, df=1457, p<.01			t=3.807, df=1459, p<.01			t= 3.946, df=1461, p<.01		
UC	H	598	3.21	1.54	598	3.27	1.46	595	3.05	1.41	595	3.14	1.35	599	1.64	.87
	L	864	3.38	1.58	864	3.37	1.51	863	3.11	1.49	860	3.09	1.39	861	1.47	.75
		t= -2.121, df=1460, p<.05			t= - 1.240, df=1460, p>.05			t= -.745, df=1321.912, p>.05			t=.798, df=1453, p>.05			t=3.923, df=1167.102, p<.01		
RT	H	598	3.03	1.19	597	3.01	1.28	593	3.13	1.32	596	3.59	1.30	599	3.45	.94
	L	863	2.71	1.15	865	2.61	1.25	864	2.84	1.31	863	3.31	1.36	861	3.39	.99
		t=5.104, df=1459, p<.01			t=5.930, df=1460, p<.01			t=4.126, df=1455, p<.01			t=3.929, df=1457, p<.01			t=1.172, df=1458, p>.05		
TE	H	599	3.66	1.16	600	3.59	1.19	595	3.60	1.21	599	3.98	1.11	597	3.60	1.05
	L	865	3.27	1.25	865	3.11	1.28	864	3.20	1.29	863	3.71	1.26	857	3.62	1.05
		t=6.191, df=1462, p<.01			t=7.139, df=1463, p<.01			t=5.924, df=1457, p<.01			t=4.333, df=1381.495, p<.01			t= -.353, df=1452, p>.05		
IW	H	600	3.05	1.33	600	3.20	1.36	596	3.24	1.34	599	3.54	1.29	596	3.55	.99
	L	865	2.83	1.31	865	2.91	1.41	864	3.13	1.42	863	3.40	1.37	858	3.45	1.00
		t=3.150, df=1463, p<.01			t=3.899, df=1463, p<.01			t=1.601, df=1458 p>.05			t=1.944, df=1334.554, p>.05			t=1.914, df=1452, p>.05		
IH	H	597	2.58	1.24	600	2.78	1.31	596	2.90	1.35	598	3.18	1.35	598	3.04	.99
	L	861	2.34	1.22	863	2.50	1.36	863	2.65	1.38	863	3.22	1.41	861	2.70	1.04
		t=3.731, df=1456, p<.01			t=4.027, df=1316.273, p<.01			t=3.509, df=1300.972, p<.01			t= -.523, df=1319.159, p>.05			t=6.294, df=1326.665, p<.01		
WD	H	600	3.27	1.15	600	3.33	1.16	596	3.30	1.18	599	3.43	1.21	593	3.29	1.06
	L	865	3.09	1.23	865	3.00	1.28	864	3.00	1.29	863	3.26	1.32	854	3.22	1.12
		t=2.802, df=1463, p<.01			t=5.035, df = 1463, p<.01			t=4.541, df=1458, p<.01			t=2.588, df=1357.025, p<.05			t=1.170, df=1445, p>.05		
GD	H	600	3.26	1.22	600	3.32	1.23	596	3.27	1.20	598	3.38	1.24	594	2.53	.91
	L	865	3.03	1.22	865	2.98	1.22	864	3.01	1.24	862	3.13	1.22	856	2.33	.92
		t=3.544, df=1283.626, p<.01			t=5.209, df=1287.518, p<.01			t=3.984, df=1458, p<.01			t=3.769, df=1274.644, p<.01			t=4.067, df=1448, p<.01		

Table 7.4.2: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils perceiving their teachers praising them because of better achievement than others with lower frequency and higher frequency at 8th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	1079	2.82	1.33	1077	2.78	1.27	1075	2.62	1.17	1075	2.82	1.21	1072	1.49	.63
	L	1008	2.80	1.40	1004	2.53	1.30	1000	2.42	1.23	1004	2.67	1.30	1002	1.34	.57
		t=.343, df=2056.821, p>.05			t=4.375, df=2061.819, p<.01			t=3.692, df=2043.937, p<.01			t=2.831, df=2038.635, p<.01			t=5.583, df=2069.740, p<.01		
UC	H	1078	3.12	1.52	1075	3.02	1.37	1073	2.70	1.27	1073	2.66	1.21	1072	1.39	.70
	L	1008	2.97	1.52	1004	2.77	1.42	999	2.50	1.29	1001	2.47	1.22	1004	1.30	.64
		t=2.114, df=2084, p<.05			t=4.111, df=2055.679, p<.01			t=3.657, df=2070, p<.01			t=3.569, df=2072, p<.01			t=2.902, df=2073.402, p<.01		
RT	H	1078	2.69	1.19	1074	2.58	1.17	1075	2.90	1.21	1073	3.24	1.22	1068	3.08	1.11
	L	1007	2.52	1.18	1000	2.30	1.16	1000	2.66	1.26	1004	3.05	1.29	998	2.98	1.20
		t=3.289, df=2083, p<.01			t=5.440, df=2072, p<.01			t=4.471, df=2045.328, p<.01			t=3.478, df=2075, p<.01			t=2.111, df=2021.353, p<.05		
TE	H	1079	3.57	1.17	1077	3.40	1.16	1075	3.63	1.15	1075	3.99	1.00	1066	4.10	.95
	L	1008	3.14	1.28	1003	2.96	1.25	1000	3.22	1.27	1003	3.64	1.18	1000	3.90	1.07
		t=8.006, df=2085, p<.01			t=8.309, df=2078, p<.01			t=7.801, df=2010.645, p<.01			t=7.258, df=1973,204, p<.01			t=4.509, df=1996.739, p<.01		
IW	H	1079	3.37	1.23	1077	3.44	1.25	1075	3.68	1.22	1075	3.88	1.11	1064	3.87	.91
	L	1008	3.10	1.29	1003	3.21	1.32	1000	3.47	1.32	1004	3.69	1.22	1001	3.81	.89
		t=4.839, df=2085, p<.01			t=4.120, df=2078, p<.01			t=3.064, df=2024.848, p<.01			t=3.735, df=2023.912, p<.01			t=1.690, df=2063, p>.05		
IH	H	1079	3.06	1.30	1077	3.38	1.29	1075	3.67	1.25	1075	4.13	1.06	1065	3.29	1.05
	L	1008	2.86	1.33	1004	3.11	1.41	999	3.32	1.40	1003	3.92	1.22	1000	2.90	1.11
		t=3.575, df=2085, p<.01			t=4.625, df=2026.152, p<.01			t=5.930, df=2005.781, p<.01			t=4.116, df=1983.966, p<.01			t=8.147, df=2063, p<.01		
WD	H	1079	2.63	1.21	1077	2.61	1.17	1074	2.53	1.14	1075	2.63	1.12	1066	1.99	.96
	L	1008	2.45	1.22	1004	2.32	1.18	1000	2.28	1.12	1004	2.40	1.18	994	1.73	.90
		t=3.447, df=2085, p<.01			t=5.447, df=2079, p<.01			t=5.154, df=2072, p<.01			t=4.419, df=2045.688, p<.01			t=6.455, df=2058, p<.01		
GD	H	1079	2.81	1.30	1076	2.82	1.27	1072	2.70	1.21	1074	2.74	1.16	1065	1.62	.82
	L	1008	2.65	1.31	1004	2.54	1.27	1000	2.44	1.18	1004	2.49	1.21	992	1.44	.72
		t=2.718, df=2085, p<.01			t=5.020, df=2078, p<.01			t=4.920, df=2070, p<.01			t=4.770, df=2051.647, p<.01			t=5.269, df=2048.138, p<.01		

Table 7.4.3: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils perceiving their teachers praising them because of improvement of results than before with lower frequency and higher frequency at 5^{th} grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	728	3.42	1.30	728	3.41	1.30	724	3.31	1.26	726	3.55	1.29	727	2.48	.94
	L	739	3.17	1.35	739	3.12	1.36	737	3.07	1.33	736	3.23	1.32	738	2.33	.89
		t=3.740, df=1465, p<.01			t=4.086, df=1465, p<.01			t=3.623, df=1459, p<.01			t=4.694, df=1460, p<.01			t=3.132, df=1455.596, p<.01		
UC	H	726	3.25	1.55	726	3.31	1.47	724	3.06	1.42	721	3.16	1.35	726	1.58	.83
	L	738	3.37	1.58	738	3.36	1.51	736	3.11	1.50	736	3.06	1.39	736	1.49	.78
		t= -1.425, df=1462, p>.05			t= -.595, df=1462, p>.05			t= -.664, df=1455.853, p>.05			t=1.349, df=1455, p>.05			t=2.127, df=1450.101, p<.05		
RT	H	725	2.98	1.18	725	2.97	1.28	722	3.10	1.34	723	3.56	1.31	725	3.45	.94
	L	738	2.70	1.16	739	2.58	1.24	737	2.82	1.29	738	3.29	1.36	737	3.38	1.00
		t=4.552, df=1459.720, p<.01			t=5.904, df=1462, p<.01			t=4.071, df=1457, p<.01			t=3.865, df=1459, p<.01			t=1.294, df=1460, p>.05		
TE	H	727	3.60	1.19	728	3.55	1.22	724	3.58	1.23	726	4.02	1.09	722	3.60	1.04
	L	739	3.26	1.24	739	3.06	1.27	737	3.16	1.29	738	3.63	1.28	734	3.62	1.06
		t=5.393, df=1464, p<.01			t=7.427, df=1465, p<.01			t=6.324, df=1459, p<.01			t=6.265, df=1434.637, p<.01			t= -.466, df=1454, p>.05		
IW	H	728	2.97	1.32	728	3.12	1.37	725	3.24	1.37	726	3.50	1.32	722	3.50	.99
	L	739	2.87	1.33	739	2.94	1.42	737	3.11	1.41	738	3.42	1.36	734	3.48	1.01
		t=1.443, df=1465, p>.05			t=2.490, df=1465, p<.05			t=1.717, df=1460, p>.05			t=1.081, df=1462, p>.05			t=.259, df=1454, p>.05		
IH	H	724	2.54	1.24	727	2.74	1.33	724	2.87	1.36	725	3.24	1.36	724	3.05	1.01
	L	736	2.34	1.22	738	2.49	1.35	737	2.64	1.37	738	3.17	1.42	737	2.63	1.02
		t=3.216, df=1458, p<.01			t=3.564, df=1463, p<.01			t=3.114, df=1459, p<.01			t=.934, df=1461, p>.05			t=7.930, df=1458.955, p<.01		
WD	H	728	3.32	1.16	728	3.33	1.18	725	3.29	1.20	726	3.50	1.22	720	3.35	1.08
	L	739	3.01	1.22	739	2.94	1.28	737	2.95	1.28	738	3.16	1.31	729	3.16	1.11
		t=4.935, df=1465, p<.01			t=6.154, df=1465, p<.01			t=5.244, df=1460, p<.01			t=5.106, df=1462, p<.01			t=3.295, df=1447, p<.01		
GD	H	728	3.26	1.22	739	2.93	1.23	725	3.27	1.19	724	3.40	1.23	719	2.51	.92
	L	739	3.00	1.22	728	3.31	1.21	737	2.96	1.25	738	3.07	1.21	733	2.33	.92
		t=4.151, df=1464.734, p<.01			t=5.861, df=1465, p<.01			t=4.838, df=1460, p<.01			t=5.249, df=1458.623, p<.01			t=3.758, df=1450, p<.01		

Table 7.4.4: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils perceiving their teachers praising them because of improvement of results than before with lower frequency and higher frequency at 8th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	1247	2.85	1.33	1243	2.77	1.26	1243	2.61	1.16	1242	2.82	1.20	1239	1.49	.63
	L	846	2.76	1.41	844	2.49	1.31	838	2.40	1.25	843	2.64	1.32	842	1.31	.56
		t=1.490, df=1744.085, p>.05			t=4.868, df=1762.012, p<.01			t=3.724, df=1710.274, p<.01			t=3.225, df=1688.847, p<.01			t=6.642, df= 1942.185, p<.01		
UC	H	1246	3.12	1.50	1241	3.00	1.37	1240	2.68	1.26	1240	2.65	1.19	1240	1.37	.69
	L	846	2.94	1.54	844	2.75	1.43	838	2.49	1.30	840	2.45	1.25	843	1.31	.64
		t=2.576, df=2090, p<.05			t=3.952, df=1759.939, p<.01			t=3.363, df=1751.199, p<.01			t=3.698, df=1741.020, p<.01			t=2.047, df=1884.027, p<.05		
RT	H	1246	2.66	1.17	1239	2.54	1.15	1243	2.85	1.19	1240	3.22	1.22	1235	3.03	1.11
	L	845	2.54	1.21	841	2.31	1.19	838	2.70	1.31	843	3.05	1.30	838	3.04	1.22
		t=2.378, df=1763.632, p<.05			t=4.392, df=2078, p<.01			t=2.622, df=1681.586, p<.01			t=2.937, df=2081, p<.01			t= -.118, df=1677.934, p>.05		
TE	H	1247	3.54	1.17	1243	3.38	1.15	1243	3.61	1.15	1241	3.99	.98	1232	4.06	.96
	L	846	3.11	1.30	843	2.91	1.27	838	3.17	1.29	843	3.58	1.22	841	3.91	1.10
		t=7.794, df=1679.458, p<.01			t=8.567, df=1687.742, p<.01			t=8.065, df=1649.189, p<.01			t=8.098, df=1549.291, p<.01			t=3.074, df=1640.347, p<.01		
IW	H	1247	3.32	1.22	1243	3.40	1.25	1243	3.62	1.23	1242	3.86	1.12	1233	3.84	.90
	L	846	3.12	1.32	843	3.22	1.34	838	3.52	1.32	843	3.68	1.21	839	3.85	.90
		t=3.518, df=1717.954, p<.01			t=3.064, df=1723.626, p<.01			t=1.781, df=1714.530, p>.05			t=3.457, df=1712.291, p<.01			t= -.230, df=2070, p>.05		
IH	H	1247	3.06	1.29	1243	3.40	1.29	1243	3.65	1.26	1242	4.14	1.06	1231	3.28	1.04
	L	846	2.83	1.36	844	3.04	1.42	837	3.29	1.41	842	3.87	1.24	841	2.83	1.11
		t=3.961, df=1750.114, p<.01			t=5.833, df=1695.395, p<.01			t=5.819, df=1650.810, p<.01			t=5.102, df=1611.770, p<.01			t=9.314, df=2070, p<.01		
WD	H	1247	2.64	1.20	1243	2.61	1.15	1242	2.53	1.12	1242	2.63	1.11	1233	1.99	.96
	L	846	2.40	1.23	844	2.27	1.21	838	2.23	1.14	843	2.36	1.20	834	1.67	.86
		t=4.348, df=2091, p<.01			t=6.353, df=1756.698, p<.01			t=6.123, df=2078, p<.01			t=5.112, df=1705.587, p<.01			t=7.761, df=2065, p<.01		
GD	H	1247	2.81	1.30	1242	2.80	1.25	1240	2.70	1.20	1241	2.75	1.17	1228	1.61	.81
	L	846	2.62	1.32	844	2.50	1.28	838	2.38	1.18	843	2.43	1.20	836	1.42	.70
		t=3.142, df=2091, p<.01			t=5.232, df=1779.460, p<.01			t=6.030, df=2076, p<.01			t=5.942, df=1775.398, p<.01			t=5.538, df=1945.316, p<.01		

Table 7.4.5: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils perceiving their teachers praising them because of more effort than others with lower frequency and higher frequency at 5th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	877	3.46	1.27	877	3.41	1.27	872	3.31	1.25	874	3.55	1.26	876	2.50	.92
	L	592	3.05	1.38	592	3.05	1.40	591	3.00	1.36	590	3.15	1.36	591	2.27	.89
		t=5.896, df=1467, p<.01			t=5.179, df=1467, p<.01			t=4.531, df=1461, p<.01			t=5.788, df=1462, p<.01			t=4.712, df=1295.389, p<.01		
UC	H	875	3.28	1.55	875	3.31	1.47	872	3.05	1.43	870	3.13	1.34	874	1.58	.81
	L	591	3.36	1.59	591	3.36	1.52	590	3.14	1.50	589	3.08	1.43	590	1.48	.79
		t=.999, df=1464, p>.05			t=.680, df=1464, p>05			t=1.113, df=1222.890, p>.05			t=.707, df=1457, p>.05			t=2.390, df=1294.601, p<.05		
RT	H	874	2.98	1.16	874	2.94	1.28	870	3.09	1.30	873	3.53	1.27	874	3.45	.94
	L	591	2.63	1.18	592	2.53	1.24	591	2.76	1.33	590	3.27	1.43	590	3.37	1.01
		t=5.598, df=1256.838, p<.01			t=6.007, df=1464, p<.01			t=4.792, df=1459, p<.01			t=3.588, df=1165.285, p<.01			t=1.419, df=1198.617, p>.05		
TE	H	876	3.57	1.17	877	3.51	1.22	872	3.52	1.23	875	3.99	1.09	870	3.65	1.02
	L	592	3.22	1.28	592	3.01	1.28	591	3.14	1.30	591	3.57	1.32	588	3.56	1.09
		t=5.412, df=1466, p<.01			t=7.609, df=1467, p<.01			t=5.623, df=1461, p<.01			t=6.325, df=1106.149, p<.01			t=1.593, df=1206.068, p>.05		
IW	H	877	2.94	1.31	877	3.12	1.38	873	3.24	1.35	875	3.51	1.29	868	3.51	.98
	L	592	2.89	1.34	592	2.90	1.42	591	3.08	1.44	591	3.38	1.41	590	3.46	1.03
		t=.813, df=1467, p>.05			t=3.062, df=1467, p<.01			t=2.166, df=1462, p<.05			t=1.756, df=1194.361, p>.05			t=1.065, df=1456, p>.05		
IH	H	872	2.49	1.21	876	2.69	1.32	872	2.84	1.33	874	3.26	1.35	872	3.02	.98
	L	590	2.36	1.27	591	2.49	1.37	591	2.62	1.42	591	3.14	1.44	591	2.57	1.05
		t=1.922, df=1460, p>.05			t=2.751, df=1465, p<.01			t=3.000, df=1212.340, p<.01			t=1.634, df=1463, p>.05			t=8.286, df=1215.185, p<.01		
WD	H	877	3.33	1.16	877	3.32	1.19	873	3.31	1.19	875	3.50	1.20	866	3.42	1.04
	L	592	2.92	1.23	592	2.87	1.27	591	2.84	1.30	591	3.08	1.35	585	3.01	1.14
		t=6.438, df=1467, p<.01			t=6.921, df=1467, p<.01			t=6.915, df=1185.156, p<.01			t=6.179, df=1167.956, p<.01			t=6.991, df=1449, p<.01		
GD	H	877	3.28	1.20	877	3.31	1.17	873	3.28	1.16	873	3.42	1.19	868	2.51	.91
	L	592	2.90	1.23	592	2.84	1.28	591	2.88	1.29	591	2.95	1.24	586	2.27	.93
		t=6.011, df=1467, p<.01			t=7.160, df=1185.451, p<.01			t=6.259, df=1462, p<.01			t=7.288, df=1462, p<.01			t=4.801, df=1452, p<.01		

Table 7.4.6: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils perceiving their teachers praising them because of more effort than others with lower frequency and higher frequency at 8th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	1124	2.87	1.33	1122	2.80	1.26	1121	2.64	1.16	1121	2.86	1.21	1114	1.50	.65
	L	968	2.74	1.40	964	2.50	1.31	959	2.40	1.23	963	2.61	1.30	965	1.31	.54
		T=2.130, df=2012.592, p<.05			t=5.197, df=2011.118, p<.01			t=4.481, df=1988.792, p<.01			t=4.513, df=1981.461, p<.01			t=7.309, df=2074.285, p<.01		
UC	H	1123	3.10	1.50	1120	2.99	1.35	1118	2.67	1.25	1120	2.65	1.18	1116	1.40	.70
	L	968	2.99	1.55	964	2.79	1.44	959	2.52	1.31	959	2.47	1.25	965	1.28	.63
		t=1.670, df=2089, p>.05			t=3.242, df=1994.199, p<.01			t=2.710, df=1994.798, p<.01			t=3.241, df=1990.617, p<.01			t=4.009, df=2074.988, p<.01		
RT	H	1123	2.68	1.16	1116	2.57	1.15	1120	2.87	1.19	1119	3.26	1.22	1112	3.05	1.11
	L	967	2.53	1.21	963	2.31	1.18	960	2.69	1.29	963	3.03	1.29	959	3.01	1.20
		t=3.003, df=2016.538, p<.01			t=5.011, df=2077, p<.01			t=3.428, df=1975.281, p<.01			t=4.114, df=2080, p<.01			t=.835, df=1968.569, p>.05		
TE	H	1124	3.56	1.14	1122	3.41	1.15	1121	3.64	1.15	1120	4.01	.96	1109	4.09	.95
	L	968	3.13	1.31	963	2.93	1.26	959	3.19	1.27	963	3.60	1.21	962	3.89	1.08
		t=7.914, df=1931.555, p<.01			t=9.260, df=2083, p<.01			t=8.366, df=1950.275, p<.01			t=8.440, df=1823.685, p<.01			t=4.488, df=1926.065, p<.01		
IW	H	1124	3.35	1.22	1122	3.43	1.25	1121	3.64	1.24	1121	3.88	1.11	1109	3.85	.90
	L	968	3.11	1.31	963	3.20	1.32	959	3.50	1.30	963	3.69	1.22	961	3.83	.90
		t=4.359, df=1992.128, p<.01			t=4.090, df=2083, p<.01			t=2.487, df=1998.292, p<.05			t=3.747, df=1966.841, p<.01			t=.601, df=2068, p>.05		
IH	H	1124	3.08	1.28	1122	3.43	1.28	1121	3.69	1.25	1121	4.15	1.04	1108	3.32	1.05
	L	968	2.83	1.35	964	3.04	1.41	958	3.29	1.40	962	3.89	1.24	962	2.85	1.08
		t=4.433, df=2009.664, p<.01			t=6.527, df=1965.806, p<.01			t=6.811, df=1930.148, p<.01			t=4.963, df=1883.018, p<.01			t=9.999, df=2068, p<.01		
WD	H	1124	2.68	1.19	1122	2.61	1.15	1120	2.55	1.12	1121	2.66	1.11	1108	2.02	.97
	L	968	2.39	1.23	964	2.31	1.20	959	2.25	1.14	963	2.36	1.18	957	1.67	.87
		t=5.439, df=2090, p<.01			t=5.777, df=2007.937, p<.01			t=5.936, df=2077, p<.01			t=5.992, df=1989.753, p<.01			t=8.575, df=2063, p<.01		
GD	H	1124	2.82	1.29	1121	2.81	1.27	1118	2.70	1.19	1120	2.76	1.16	1105	1.64	.82
	L	968	2.63	1.32	964	2.52	1.26	959	2.42	1.20	963	2.46	1.20	957	1.41	.70
		t=3.367, df=2031.571, p<.01			t=5.189, df=2083, p<.01			t=5.264, df=2075, p<.01			t=5.735, df=2014.503, p<.01			t=6.768, df=2059.918, p<.01		

Table 7.4.7: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils perceiving their teachers praising them because of increased effort with lower frequency and higher frequency at 5th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	906	3.45	1.26	906	3.44	1.26	901	3.35	1.23	902	3.55	1.23	905	2.51	.93
	L	561	3.04	1.41	561	2.99	1.41	560	2.94	1.37	560	3.13	1.39	560	2.25	.87
		T=5.896, df=1465, P<.01			t=6.173, df=1089.481, p<.01			t=5.689, df=1088.614, p<.01			t=5.966, df=1079.715, p<.01			t=5.356, df=1248.959, p<.01		
UC	H	904	3.26	1.54	904	3.29	1.48	901	3.05	1.41	899	3.12	1.33	903	1.60	.83
	L	560	3.39	1.61	560	3.41	1.51	559	3.14	1.53	558	3.09	1.43	559	1.43	.75
		t= -1.542, df=1143.708, p>.05			t= -1.585, df=1462, p>.05			t=1.174, df=1114.617, p>.05			t=.489, df=1117.347, p>.05			t=3.935, df=1273.982, p<.01		
RT	H	904	2.99	1.16	903	2.93	1.28	900	3.11	1.31	901	3.56	1.28	903	3.46	.93
	L	559	2.59	1.17	561	2.52	1.23	559	2.71	1.30	560	3.21	1.41	559	3.34	1.02
		t=6.323, df=1169.543, p<.01			t=6.161, df=1462, p<.01			t=5.633, df=1457, p<.01			t=4.866, df=1094.716, p<.01			t=2.220, df=1101.888, p<.05		
TE	H	905	3.60	1.15	906	3.53	1.19	901	3.53	1.22	904	4.00	1.09	899	3.65	1.02
	L	561	3.16	1.29	561	2.94	1.31	560	3.09	1.31	560	3.53	1.32	557	3.55	1.10
		t=6.634, df=1084.194, p<.01			t=8.746, df=1465, p<.01			t=6.534, df=1459, p<.01			t=7.129, df=1019.516, p<.01			t=1.688, df=1110.972, p>.05		
IW	H	906	2.97	1.29	906	3.14	1.39	902	3.23	1.35	904	3.53	1.28	897	3.53	.97
	L	561	2.83	1.36	561	2.86	1.40	560	3.09	1.45	560	3.33	1.43	559	3.42	1.04
		t=1.982, df=1139.847, p<.05			t=3.643, df=1465, p<.01			t=1.866, df=1120.330, p>.05			t=2.747, df=1084.551, p<.01			t=2.124, df=1118.009, p<.05		
IH	H	899	2.54	1.23	904	2.76	1.33	901	2.90	1.34	903	3.29	1.35	902	3.02	.98
	L	561	2.28	1.23	561	2.37	1.33	560	2.53	1.39	560	3.07	1.45	559	2.55	1.05
		t=3.892, df=1458, p<.01			t=5.370, df=1463, p<.01			t=5.025, df=1152.668, p<.01			t=2.976, df=1461, p<.01			t=8.536, df=1127.447, p<.01		
WD	H	906	3.34	1.15	906	3.33	1.18	902	3.29	1.19	904	3.49	1.22	894	3.37	1.07
	L	561	2.88	1.23	561	2.83	1.28	560	2.84	1.31	560	3.08	1.34	555	3.07	1.12
		t=7.264, df=1465, p<.01			t=7.621, df=1465, p<.01			t=6.553, df=1096.099, p<.01			t=6.066, df=1462, p<.01			t=5.159, df=1447, p<.01		
GD	H	906	3.27	1.20	906	3.30	1.18	902	3.28	1.15	902	3.38	1.19	897	2.50	.91
	L	561	2.90	1.23	561	2.82	1.27	560	2.86	1.30	560	3.00	1.25	555	2.28	.93
		t=5.781, df=1465, p<.01			t=7.353, df=1465, p<.01			t=6.354, df=1078.917, p<.01			t=5.802, df=1460, p<.01			t=4.460, df=1450, p<.01		

Table 7.4.8: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils perceiving their teachers praising them because of increased effort with lower frequency and higher frequency at 8th grade

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	1225	2.87	1.34	1223	2.77	1.25	1222	2.62	1.16	1222	2.83	1.20	1215	1.50	.64
	L	868	2.74	1.40	864	2.50	1.32	859	2.39	1.24	863	2.63	1.32	865	1.29	.53
		t=2.043, df=1816.698, p<.05			t=4.701, df=1798.335, p<.01			t=4.228, df=1772.861, p<.01			t=3.584, df=1745.784, p<.01			t=8.189, df=2033.468, p<.01		
UC	H	1224	3.11	1.51	1221	2.99	1.36	1219	2.68	1.25	1221	2.63	1.19	1217	1.39	.70
	L	868	2.96	1.53	864	2.77	1.44	859	2.50	1.31	859	2.48	1.25	865	1.28	.63
		t=2.287, df=2090, p<.05			t=3.448, df=1787.128, p<.01			t=3.024, df=1797.521, p<.01			t=2.723, df=1794.730, p<.01			t=3.878, df=1968.891, p<.01		
RT	H	1224	2.67	1.16	1219	2.57	1.14	1222	2.88	1.19	1220	3.25	1.21	1210	3.04	1.11
	L	867	2.52	1.22	861	2.27	1.19	859	2.67	1.30	863	3.01	1.31	862	3.03	1.21
		t=2.852, df=1809.854, p<.01			t=5.787, df=2087, p<.01			t=3.751, df=1738.390, p<.01			t=4.374, df=2081, p<.01			t=.119, df=1759.975, p>.05		
TE	H	1225	3.54	1.16	1223	3.40	1.14	1222	3.63	1.15	1221	3.99	.99	1210	4.06	.96
	L	868	3.11	1.31	863	2.89	1.27	859	3.16	1.28	863	3.58	1.20	862	3.91	1.08
		t=7.759, df=1721.129, p<.01			t=9.429, df=1731.843, p<.01			t=8.510, df=1720.501, p<.01			t=8.303, df=1618.795, p<.01			t=3.365, df=1714.599, p<.01		
IW	H	1225	3.32	1.23	1223	3.43	1.24	1222	3.63	1.24	1222	3.88	1.10	1211	3.84	.89
	L	868	3.12	1.31	863	3.18	1.34	859	3.51	1.31	863	3.67	1.23	860	3.84	.91
		t=3.399, df=1789.029, p<.01			t=4.276, df=1760.508, p<.01			t=2.116, df=1784.776, p<.05			t=4.018, df=1726.000, p<.01			t=.118, df=2069, p>.05		
IH	H	1225	3.06	1.28	1223	3.40	1.28	1222	3.64	1.26	1222	4.14	1.05	1208	3.30	1.05
	L	868	2.82	1.37	864	3.04	1.42	858	3.31	1.42	862	3.87	1.25	863	2.82	1.09
		t=4.152, df=1782.397, p<.01			t=5.899, df=1738.344, p<.01			t=5.549, df=1699.555, p<.01			t=5.072, df=1639.254, p<.01			t=9.942, df=2069, p<.01		
WD	H	1225	2.66	1.19	1223	2.61	1.16	1221	2.54	1.13	1222	2.63	1.11	1210	2.00	.95
	L	868	2.38	1.23	864	2.27	1.19	859	2.22	1.13	863	2.36	1.20	856	1.66	.88
		t=5.336, df=2091, p<.01			t=6.414, df=2085, p<.01			t=6.445, df=2078, p<.01			t=5.340, df=1770.648, p<.01			t=8.443, df=2064, p<.01		
GD	H	1225	2.83	1.30	1222	2.80	1.26	1219	2.70	1.20	1221	2.75	1.17	1208	1.62	.81
	L	868	2.60	1.31	864	2.52	1.27	859	2.40	1.18	863	2.44	1.20	855	1.40	.70
		t=4.054, df=2091, p<.01			t=4.938, df=2084, p<.01			t=5.687, df=2076, p<.01			t=5.953, df=1823.779, p<.01			t=6.689, df=1981.350, p<.01		

Table 7.4.9: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils feeling happy strongly and less strongly with praise given for better results than others at 5th grade.

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	740	3.41	1.31	740	3.41	1.32	738	3.32	1.29	739	3.56	1.29	739	2.41	.88
	L	721	3.17	1.35	721	3.12	1.33	717	3.06	1.30	717	3.21	1.31	719	2.41	.95
		T=3.419, df=1459, P<.01			t=4.097, df=1459, p<.01			t=3.829, df=1453, p<.01			t=5.273, df=1454, p<.01			t=.109, df=1442.831, p>.05		
UC	H	738	3.39	1.53	738	3.44	1.46	738	3.19	1.44	737	3.23	1.34	737	1.57	.80
	L	720	3.23	1.59	720	3.23	1.52	716	2.98	1.48	715	2.99	1.40	718	1.50	.80
		t=1.934, df=1456, p>.05			t=2.706, df=1456, p<.01			t=2.686, df=1452, p<.01			t=3.312, df=1450, p<.01			t=1.830, df=1453, p>.05		
RT	H	739	3.01	1.18	739	2.93	1.28	738	3.13	1.31	739	3.54	1.32	737	3.49	.98
	L	718	2.65	1.14	719	2.59	1.24	715	2.79	1.30	716	3.31	1.36	718	3.33	.96
		t=5.888, df=1455, p<.01			t=5.125, df=1456, p<.01			t=5.047, df=1451, p<.01			t=3.279, df=1453, p<.01			t=3.176, df=1453, p<.01		
TE	H	739	3.54	1.21	740	3.44	1.23	738	3.48	1.24	739	3.92	1.15	736	3.71	1.04
	L	721	3.32	1.24	721	3.16	1.30	717	3.25	1.29	719	3.71	1.25	713	3.51	1.05
		t=3.475, df=1458, p<.01			t=4.279, df=1459, p<.01			t=3.569, df=1453, p<.01			t=3.434, df=1439.255, p<.01			t=3.748, df=1447, p<.01		
IW	H	740	3.05	1.33	740	3.15	1.39	739	3.28	1.36	739	3.55	1.32	737	3.58	.96
	L	721	2.78	1.30	721	2.90	1.41	717	3.06	1.40	719	3.37	1.35	712	3.39	1.03
		t=3.837, df=1459, p<.01			t=3.473, df=1459, p<.01			t=3.040, df=1454, p<.01			t=2.543, df=1456, p<.05			t=3.645, df=1447, p<.01		
IH	H	736	2.59	1.27	740	2.84	1.35	739	2.94	1.38	739	3.36	1.33	736	2.92	1.03
	L	718	2.29	1.19	719	2.38	1.30	716	2.56	1.34	719	3.06	1.44	718	2.75	1.02
		t=4.577, df=1449.693, p<.01			t=6.723, df=1457, p<.01			t=5.304, df=1453, p<.01			t=4.141, df=1439.437, p<.01			t=3.212, df=1452, p<.01		
WD	H	740	3.21	1.18	740	3.26	1.21	739	3.24	1.26	739	3.45	1.24	730	3.31	1.11
	L	721	3.12	1.23	721	3.01	1.26	717	2.99	1.24	719	3.21	1.30	711	3.19	1.08
		t=1.473, df=1459, p>.05			t=3.894, df=1459, p<.01			t=3.954, df=1453.499, p<.01			t=3.526, df=1456, p<.01			t=1.981, df=1439, p<.05		
GD	H	740	3.24	1.19	740	3.26	1.22	739	3.28	1.20	739	3.39	1.22	733	2.42	.92
	L	721	3.01	1.25	721	2.97	1.24	717	2.95	1.23	717	3.07	1.22	712	2.40	.92
		t=3.728, df=1459, p<.01			t=4.598, df=1459, p<.01			t=5.183, df=1454, p<.01			t=4.958, df=1454, p<.01			t=.439, df=1443, p>.05		

Table 7.4.10: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils feeling happy strongly and less strongly with praise given for better results than others at 8th grade.

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	1255	2.87	1.34	1252	2.75	1.29	1250	2.64	1.18	1248	2.84	1.23	1247	1.43	.62
	L	851	2.74	1.39	848	2.52	1.27	843	2.37	1.22	846	2.63	1.27	846	1.39	.59
		T=2.246, Df=1786.350, p<.05			t=4.002, df=2098, p<.01			t=4.925, df=1764.103, p<.01			t=3.903, df=1773.590, p<.01			t=1.603, df=2091, p>.05		
UC	H	1254	3.15	1.51	1250	3.04	1.37	1247	2.74	1.29	1245	2.67	1.22	1246	1.35	.67
	L	851	2.90	1.52	848	2.70	1.40	843	2.42	1.24	844	2.43	1.21	848	1.34	.68
		t=3.785, df=2103, p<.01			t=5.533, df=1789.775, p<.01			t=5.560, df=2088, p<.01			t=4.494, df=2087, p<.01			t=.224, df=2092, p>.05		
RT	H	1254	2.67	1.18	2148	2.56	1.19	1249	2.93	1.22	1246	3.30	1.23	1240	3.10	1.13
	L	850	2.52	1.17	845	2.28	1.13	844	2.58	1.23	846	2.93	1.26	845	2.94	1.18
		t=3.016, df=2102, p<.01			t=5.347, df=2091, p<.01			t=6.357, df=1798.291, p<.01			t=6.598, df=2090, p<.01			t=3.173, df=2083, p<.01		
TE	H	1255	3.47	1.21	1252	3.35	1.19	1250	3.59	1.17	1248	3.96	1.04	1238	4.08	.98
	L	851	3.22	1.26	847	2.95	1.24	843	3.21	1.27	845	3.61	1.17	846	3.88	1.06
		t=4.557, df=2104, p<.01			t=7.442, df=2097, p<.01			t=7.123, df=2091, p<.01			t=6.996, df=1663.182, p<.01			t=4.318, df=1709.561, p<.01		
IW	H	1255	3.32	1.25	1252	3.43	1.25	1250	3.71	1.22	1248	3.90	1.11	1241	3.88	.88
	L	851	3.12	1.27	847	3.19	1.32	843	3.39	1.32	846	3.63	1.21	843	3.77	.93
		t=3.544, df=2104, p<.01			t=4.151, df=2097, p<.01			t=5.659, df=1716.446, p<.01			t=5.264, df=1710.348, p<.01			t=2.726, df=1742.195, p<.01		
IH	H	1255	3.09	1.31	1252	3.45	1.32	1249	3.69	1.27	1248	4.18	1.04	1242	3.21	1.07
	L	851	2.80	1.32	848	2.98	1.35	843	3.26	1.38	845	3.81	1.25	843	2.95	1.11
		t=4.964, df=2104, p<.01			t=7.880, df=2098, p<.01			t=7.111, df=1702.085, p<.01			t=7.059, df=1590.931, p<.01			t=5.417, df=2083, p<.01		
WD	H	1255	2.65	1.21	1252	2.58	1.19	1249	2.52	1.13	1248	2.60	1.13	1237	1.91	.95
	L	851	2.74	1.22	848	2.31	1.16	843	2.26	1.14	846	2.41	1.17	842	1.80	.92
		t=4.280, df=2104, p<.01			t=5.080, df=2098, p<.01			t=5.166, df=2090, p<.01			t=3.616, df=2092, p<.01			t=2.698, df=2077, p<.01		
GD	H	1255	2.81	1.30	1251	2.76	1.28	1247	2.68	1.20	1247	2.68	1.18	1238	1.56	.79
	L	851	2.64	1.32	848	2.56	1.27	843	2.43	1.20	846	2.54	1.19	836	1.49	.75
		t=2.840, df=2104, p<.01			t=3.466, df=2097, p<.01			t=4.598, df=2088, p<.01			t=2.649, df=2091, p<.01			t=2.042, df=2072, p<.05		

Table 7.4.11: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils feeling happy strongly and less strongly with praise given for improvement of results than others at 5th grade.

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	915	3.44	1.30	915	3.44	1.30	912	3.36	1.26	911	3.59	1.26	912	2.48	.92
	L	545	3.04	1.35	545	2.98	1.34	542	2.91	1.32	544	3.04	1.32	545	2.29	.90
		t=5.526, df=1458, p<.01			t=6.570, df=1458, p<.01			t=6.465, df=1452, p<.01			t=7.919, df=1453, p<.01			t=3.824, df=1455, p<.01		
UC	H	913	3.35	1.55	913	3.36	1.46	912	3.11	1.43	908	3.16	1.35	910	1.58	.80
	L	544	3.24	1.58	544	3.28	1.55	541	3.04	1.50	543	3.02	1.41	544	1.47	.79
		t=1.264, df=1455, p>.05			t=1.084, df=1088.852, p>.05			t=.861, df=1451, p>.05			t=1.913, df=1449, p>.05			t=2.582, df=1452, p<.05		
RT	H	915	2.98	1.15	913	2.93	1.26	912	3.11	1.30	911	3.54	1.30	909	3.49	.95
	L	541	2.59	1.17	544	2.50	1.24	540	2.71	1.32	543	3.24	1.39	545	3.29	.98
		t=6.212, df=1118.735, p<.01			t=6.315, df=1455, p<.01			t= 5.582, df=1450, p<.01			t=4.176, df=1452, p<.01			t=3.853, df=1452, p<.01		
TE	H	914	3.57	1.17	915	3.47	1.22	912	3.50	1.22	912	3.97	1.12	906	3.70	1.02
	L	545	3.20	1.27	545	3.02	1.29	542	3.15	1.32	545	3.56	1.29	542	3.47	1.08
		t=5.683, df=1457, p<.01			t=6.591, df=1458, p<.01			t=5.119, df=1452, p<.01			t=6.292, df=1022.455, p<.01			t=4.116, df=1446, p<.01		
IW	H	915	3.01	1.32	915	3.12	1.40	913	3.28	1.35	912	3.58	1.29	906	3.60	.94
	L	545	2.77	1.31	545	2.87	1.39	542	2.99	1.43	545	3.26	1.39	542	3.31	1.06
		t=3.352, df=1458, p<.01			t=3.419, df=1458, p<.01			t=3.984, df=1453, p<.01			t=4.343, df=1075.826, p<.01			t=5.146, df=1037.565, p<		
IH	H	909	2.55	1.25	914	2.81	1.34	913	2.93	1.38	912	3.34	1.34	909	2.93	1.02
	L	544	2.25	1.19	544	2.29	1.29	541	2.46	1.31	545	2.98	1.44	544	2.68	1.04
		t=4.502, df=1451, p<.01			t=7.193, df=1456, p<.01			t=6.348, df=1452, p<.01			t=4.833, df=1455, p<.01			t=4.537, df=1451, p<.01		
WD	H	915	3.30	1.19	915	3.30	1.20	913	3.22	1.24	912	3.49	1.24	900	3.35	1.09
	L	545	2.93	1.19	545	2.87	1.27	542	2.96	1.27	545	3.06	1.29	541	3.09	1.09
		t=5.771, df=1458, p<.01			t=6.528, df=1458, P<.01			t=3.841, df=1453, p<.01			t=6.272, df=1455, p<.01			t=4.337, df=1439, p<.01		
GD	H	915	3.27	1.20	915	3.29	1.21	913	3.27	1.19	911	3.38	1.20	903	2.47	.93
	L	545	2.89	1.23	545	2.82	1.23	542	2.86	1.24	544	3.00	1.24	541	2.32	.90
		t=5.698, df=1458, p<.01			t=7.191, df=1458, p<.01			t=6.144, df=1453, p<.01			t=5.732, df=1453, p<.01			t=3.077, df=1442, p<.01		

Table 7.4.12: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils feeling happy strongly and less strongly with praise given for improvement of results than others at 8th grade.

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	1557	2.91	1.35	1552	2.78	1.28	1548	2.65	1.18	1548	2.87	1.23	1545	1.44	.62
	L	549	2.55	1.36	548	2.31	1.25	545	2.20	1.20	546	2.44	1.25	548	1.35	.56
		t=5.450, df=953.157, p<.01			t=7.422, df=2098, p<.01			t=7.579, df=2091, p<.01			t=6.882, df=943.841, p<.(			t=3.233, df=1055.664, p<.01		
UC	H	1556	3.15	1.50	1550	3.02	1.35	1545	2.71	1.26	1543	2.66	1.20	1546	1.36	.68
	L	549	2.78	1.54	548	2.56	1.45	545	2.34	1.30	546	2.34	1.25	548	1.29	.64
		t=4.876, df=2103, p<.01			t=6.542, df=907.650, p<.01			t=5.683, df=926.200, p<.(			t=5.158, df=923.087, p<.(			t=2.354, df=1012.349, p<.05		
RT	H	1556	2.67	1.17	1547	2.53	1.17	1547	2.90	1.21	1546	3.25	1.22	1538	3.13	1.13
	L	548	2.44	1.20	546	2.21	1.16	546	2.46	1.26	546	2.84	1.31	547	2.78	1.19
		t=3.925, df=2102, p<.01			t=5.463, df=2091, p<.01			t=7.102, df=925.581, p<.01			t=6.640, df=2090, p<.01			t=5.978, df=918.270, p<.01		
TE	H	1557	3.48	1.19	1552	3.34	1.17	1548	3.60	1.16	1548	3.95	1.02	1538	4.07	.98
	L	549	3.05	1.32	547	2.77	1.27	545	2.99	1.31	545	3.45	1.24	546	3.81	1.10
		t=7.083, df=2104, p<.01			t=9.104, df=895.868, p<.01			t=9.511, df=859.202, p<.01			t=8.483, df=820.505, p<.(			t=4.837, df=869.702, p<.01		
IW	H	1557	3.29	1.25	1552	3.40	1.25	1548	3.65	1.22	1548	3.85	1.12	1539	3.87	.87
	L	549	3.09	1.29	547	3.13	1.36	545	3.37	1.38	546	3.61	1.25	545	3.74	.97
		t=3.166, df=2104, p<.01			t=4.091, df=894.691, p<.01			t=4.233, df=864.832, p<.01			t=4.060, df=871.545, p<.01			t=2.759, df=873.082, p<.01		
IH	H	1557	3.06	1.29	1552	3.41	1.30	1548	3.67	1.26	1547	4.15	1.05	1540	3.21	1.06
	L	549	2.70	1.37	548	2.82	1.40	544	3.08	1.44	546	3.69	1.31	545	2.80	1.12
		t=5.489, df=910.476, p<.01			t=8.605, df=903.425, p<.01			t=8.405, df=855.307, p<.01			t=7.461, df=806.286, p<.(			t=7.628, df=2083, p<.01		
WD	H	1557	2.66	1.21	1552	2.58	1.18	1547	2.51	1.12	1548	2.61	1.13	1533	1.92	.94
	L	549	2.24	1.19	548	2.18	1.16	545	2.15	1.14	546	2.27	1.18	546	1.71	.93
		t=7.096, df=2104, p<.01			t=6.883, df=2098, p<.01			t=6.465, df=2090, p<.01			t=5.848, df=926.032, p<.01			t=4.506, df=2077, p<.01		
GD	H	1557	2.83	1.30	1551	2.78	1.27	1545	2.69	1.20	1547	2.70	1.17	1536	1.57	.79
	L	549	2.50	1.31	548	2.41	1.26	545	2.27	1.16	546	2.42	1.21	538	1.45	.73
		t=4.974, df=2104, p<.01			t=5.835, df=2097, p<.01			t=7.106, df=2088, p<.01			t=4.645, df=932.218, p<.(			t=3.094, df=1016.360, p<.01		

Table 7.4.13: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils feeling happy strongly and less strongly with praise given for more effort than others at 5th grade.

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	801	3.44	1.30	801	3.44	1.31	798	3.36	1.28	798	3.60	1.26	799	2.47	.90
	L	658	3.12	1.35	658	3.07	1.34	655	2.98	1.30	656	3.14	1.33	657	2.34	.92
		T=4.602, df=1457, p<.01			t=5.324, df=1457, p<.01			t=5.541, df=1451, p<.01			t=6.728, df=1452, p<.01			t=2.528, df=1454, p<.05		
UC	H	799	3.33	1.56	799	3.38	1.48	798	3.14	1.44	797	3.18	1.34	797	1.54	.79
	L	657	3.28	1.58	657	3.26	1.52	654	3.02	1.49	653	3.02	1.41	656	1.52	.82
		t=.607, df=1454, p>.05			t=1.504, df=1454, p>.05			t=1.592, df=1450, p>.05			t=2.302, df=1448, p<.05			t=.484, df=1451, p>.05		
RT	H	800	2.99	1.17	799	2.92	1.26	797	3.15	1.32	798	3.57	1.28	797	3.46	.97
	L	655	2.66	1.16	657	2.58	1.25	654	2.74	1.29	655	3.25	1.39	656	3.36	.97
		t=5.368, df=1453, p<.01			t=5.086, df=1454, p<.01			t=6.027, df=1449, p<.01			t=4.493, df=1346.964, p<.01			t=1.918, df=1451, p>.05		
TE	H	800	3.60	1.16	801	3.49	1.21	798	3.51	1.22	799	3.99	1.10	794	3.70	1.03
	L	658	3.23	1.28	658	3.07	1.30	655	3.20	1.31	657	3.61	1.29	653	3.50	1.06
		t=5.742, df=1456, p<.01			t=6.343, df=1457, p<.01			t=4.686, df=1451, p<.01			t=5.874, df=1290.913, p<.01			t=3.605, df=1445, p<.01		
IW	H	801	3.02	1.31	801	3.16	1.40	799	3.30	1.35	799	3.59	1.29	792	3.59	.96
	L	658	2.80	1.33	658	2.86	1.39	655	3.02	1.41	657	3.30	1.38	655	3.37	1.03
		t=3.151, df=1457, p<.01			t=4.075, df=1457, p<.01			t=3.762, df=1452, p<.01			t=4.101, df=1363.295, p<.01			t=4.178, df=1445, p<.01		
IH	H	795	2.54	1.23	800	2.80	1.34	798	2.93	1.36	799	3.39	1.35	797	2.90	1.02
	L	657	2.33	1.24	657	2.38	1.31	655	2.54	1.35	657	2.99	1.41	655	2.75	1.04
		t=3.205, df=1450, p<.01			t=6.009, df=1455, p<.01			t=5.520, df=1451, p<.01			t=5.518, df=1454, p<.01			t=2.912, df=1450, p<.01		
WD	H	801	3.34	1.19	801	3.32	1.22	799	3.31	1.24	799	3.53	1.22	791	3.38	1.07
	L	658	2.95	1.19	658	2.91	1.24	655	2.89	1.24	657	3.09	1.30	649	3.09	1.10
		t=6.155, df=1405.810, p<.01			t=6.298, df=1457, p<.01			t=6.530, df=1452, p<.01			t=6.703, df=1454, p<.01			t=5.051, df=1438, p<.01		
GD	H	801	3.28	1.20	801	3.34	1.20	799	3.32	1.20	799	3.44	1.17	792	2.46	.93
	L	658	2.95	1.23	658	2.84	1.23	655	2.87	1.22	655	2.99	1.25	651	2.35	.91
		t=5.126, df=1457, p<.01			t=7.817, df=1457, p<.01			t=7.060, df=1452, p<.01			t=7.078, df=1452, p<.01			t=2.353, df=1441, p<.05		

Table 7.4.14: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils feeling happy strongly and less strongly with praise given for more effort than others at 8th grade.

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	1106	2.97	1.35	1103	2.86	1.29	1101	2.72	1.17	1101	2.94	1.25	1099	1.46	.63
	L	1000	2.65	1.36	997	2.44	1.24	992	2.33	1.20	993	2.55	1.23	994	1.37	.57
		T=5.324, Df=2081.738, p<.01			t=7.516, df=2098, p<.01			t=7.575, df=2059.646, p<.01			t=7.369, df=2075.588, p<.01			t=3.235, df=2090.976, p<.01		
UC	H	1105	3.21	1.51	1101	3.09	1.34	1098	2.78	1.25	1099	2.73	1.21	1101	1.37	.69
	L	1000	2.88	1.51	997	2.69	1.42	992	2.43	1.29	990	2.40	1.20	993	1.32	.66
		t=5.051, df=2103, p<.01			t=6.647, df=2048.176, p<.01			t=6.193, df=2054.406, p<.01			t=6.286, df=2087, p<.01			t=1.852, df=2085.159, p>.05		
RT	H	1105	2.67	1.16	1100	2.57	1.18	1102	2.96	1.24	1101	3.31	1.23	1094	3.11	1.14
	L	999	2.55	1.19	993	2.31	1.15	991	2.60	1.21	991	2.97	1.25	991	2.95	1.16
		t=2.360, df=2102, p<.05			t=5.113, df=2091, p<.01			t=6.689, df=2076.328, p<.01			t=6.318, df=2090, p<.01 .			t=3.195, df=2083, p<.01		
TE	H	1106	3.52	1.19	1103	3.40	1.20	1101	3.65	1.16	1101	3.98	1.05	1092	4.09	.98
	L	1000	3.20	1.27	996	2.96	1.22	992	3.21	1.26	992	3.65	1.14	992	3.90	1.05
		t=6.013, df=2104, p<.01			t=8.440, df=2097, p<.01			t=8.237, df=2022.904, p<.01			t=6.828, df=2016.337, p<.01			t=4.211, df=2029.020, p<.01		
IW	H	1106	3.32	1.25	1103	3.43	1.27	1101	3.73	1.21	1101	3.92	1.11	1092	3.86	.88
	L	1000	3.14	1.27	996	3.22	1.30	992	3.42	1.32	993	3.65	1.20	992	3.81	.93
		t=3.346, df=2104, p<.01			t=3.604, df=2097, p<.01			t=5.552, df=2015.040, p,.01			t=5.282, df=2030.932, p<.01			t=1.367, df=2040.344, p>.05		
IH	H	1106	3.15	1.30	1103	3.49	1.31	1101	3.76	1.25	1101	4.21	1.04	1094	3.25	1.08
	L	1000	2.77	1.32	997	3.00	1.36	991	3.25	1.37	992	3.83	1.22	991	2.94	1.09
		t=6.610, df=2104, p<.01			t=8.359, df=2098, p<.01			t=8.880, df=2011.867, p<.01			t=7.487, df=1959.276, p<.01			t=6.649, df=2083, p<.01		
WD	H	1106	2.71	1.21	1103	2.64	1.19	1100	2.59	1.13	1101	2.67	1.14	1087	1.94	.96
	L	1000	2.38	1.21	997	2.29	1.15	992	2.22	1.11	993	2.36	1.14	992	1.79	.90
		t=6.150, df=2104, p<.01			t=6.976, df=2098, p<.01			t=7.641, df=2090, p<.01			t=6.185, df=2092, p<.01			t=3.632, df=2077, p<.01		
GD	H	1106	2.87	1.30	1102	2.85	1.27	1098	2.76	1.19	1100	2.76	1.18	1093	1.59	.82
	L	1000	2.60	1.30	997	2.50	1.25	992	2.39	1.18	993	2.48	1.18	981	1.47	.72
		t=4.662, df=2104, p<.01			t=6.354, df=2097, p<.01			t=7.151, df=2088, p<.01			t=5.289, df=2091, p<.01			t=3.602, df=2070.951, p<.01		

Table 7.4.15: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils feeling happy strongly and less strongly with praise given for more effort than before at 5th grade.

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	970	3.44	1.29	970	3.43	1.29	966	3.36	1.25	966	3.60	1.26	967	2.50	.90
	L	491	3.00	1.36	491	2.95	1.36	489	2.84	1.33	490	2.98	1.32	491	2.25	.92
		T=6.116, df=1459, P<.01			t=6.655, df=1459, p<.01			t=7.327, df=1453, p<.01			t=8.725, df=1454, p<.01			t=4.946, df=1456, p<.01		
UC	H	968	3.34	1.55	968	3.40	1.46	966	3.12	1.44	965	3.17	1.34	965	1.56	.79
	L	490	3.24	1.60	490	3.19	1.55	488	3.00	1.51	487	2.97	1.43	490	1.49	.81
		t=1.165, df=1456, p>.05			t=2.417, df=934.127, p<.05			t=1.558, df=1452, p>.05			t=2.662, df=1450, p<.01			t=1.480, df=1453, p>.05		
RT	H	968	2.96	1.17	968	2.90	1.27	965	3.12	1.32	967	3.56	1.29	964	3.49	.96
	L	489	2.60	1.16	490	2.51	1.25	488	2.67	1.27	488	3.17	1.40	491	3.27	.97
		t=5.624, df=982.078, p<.01			t=5.518, df=1456, p<.01			t=6.226, df=1451, p<.01			t=5.188, df=908.992, p<.01			t=4.052, df=1453, p<.01		
TE	H	969	3.55	1.17	970	3.46	1.22	966	3.51	1.22	968	3.98	1.12	962	3.71	1.01
	L	491	3.19	1.30	491	2.99	1.30	489	3.10	1.32	490	3.49	1.30	487	3.43	1.10
		t=5.171, df=899.331, p<.01			t=6.872, df=1459, p<.01			t=5.797, df=1453, p<.01			t=7.159, df=861.376, p<.01			t=4.683, df=906.651, p<.01		
IW	H	970	2.99	1.31	970	3.13	1.40	967	3.29	1.35	968	3.56	1.30	959	3.55	.96
	L	491	2.78	1.33	491	2.82	1.38	489	2.94	1.42	490	3.26	1.40	490	3.37	1.06
		t=2.773, df=1459, p<.01			t=4.016, df=1459, p<.01			t=4.614, df=1454, p<.01			t=3.971, df=918.629, p<.01			t=3.057, df=909.174, p<.01		
IH	H	963	2.55	1.25	968	2.76	1.35	966	2.90	1.36	968	3.39	1.34	964	2.90	1.02
	L	491	2.23	1.18	491	2.32	1.29	489	2.47	1.34	490	2.86	1.41	490	2.71	1.05
		t=4.821, df=1035.896, p<.01			t=5.984, df=1457, p<.01			t=5.652, df=1453, p<.01			t=7.035, df=1456, p<.01			t=3.262, df=1452, p<.01		
WD	H	970	3.29	1.20	970	3.31	1.21	967	3.28	1.24	968	3.48	1.25	955	3.36	1.07
	L	491	2.92	1.18	491	2.80	1.25	489	2.80	1.23	490	3.05	1.29	487	3.05	1.13
		t=5.597, df=1459, p<.01			t=7.550, df=1459, p<.01			t=6.965, df=1454, p<.01			t=6.175, df=1456, p<.01			t=5.169, df=1440, p<.01		
GD	H	970	3.26	1.20	970	3.31	1.20	967	3.28	1.18	966	3.40	1.20	958	2.49	.92
	L	491	2.86	1.23	491	2.74	1.23	489	2.79	1.25	490	2.91	1.23	487	2.25	.90
		t=6.018, df=1459, p<.01			t=8.415, df=1459, p<.01			t=7.247, df=1454, p<.01			t=7.364, df=1454, p<.01			t=4.782, df=1000.471, p<.01		

Table 7.4.16: Mean of frequency of deployment of teaching methods and affective attitude promoted by teaching methods between pupils feeling happy strongly and less strongly with praise given for more effort than before at 8th grade.

		Enjoyment			Motivation			Sense of security			Sense of progress			Deployment		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
PW	H	1401	2.98	1.35	1396	2.83	1.27	1394	2.69	1.18	1394	2.92	1.23	1392	1.45	.62
	L	704	2.50	1.34	703	2.32	1.26	698	2.21	1.17	699	2.42	1.24	700	1.36	.58
		T=7.743, Df=1413.936, p<.01			t=8.652, df=2097, p<.01			t=8.902, df=2090, p<.01			t=8.837, df=1389.071, p<.01			t=3.375, df=1496.149, p<.01		
UC	H	1400	3.21	1.48	1394	3.07	1.34	1391	2.75	1.26	1391	2.71	1.20	1394	1.38	.70
	L	704	2.72	1.55	703	2.56	1.43	698	2.32	1.26	697	2.29	1.20	699	1.28	.62
		t=6.950, df=1349.435, p<			t=7.779, df=1337.468, p<			t=7.389, df=2087, p<.01			t=7.539, df=2086, p<.01			t=3.380, df=1548.537, p<.01		
RT	H	1400	2.67	1.17	1391	2.53	1.17	1394	2.92	1.23	1393	3.26	1.23	1386	3.14	1.14
	L	703	2.50	1.20	701	2.28	1.15	698	2.52	1.22	698	2.93	1.28	698	2.82	1.15
		t=3.135, df=2101, p<.01			t=4.713, df=2090, p<.01			t=6.978, df=1409.812, p<.01			t=5.714, df=2089, p<.01			t=6.001, df=2082, p<.01		
TE	H	1401	3.48	1.19	1396	3.35	1.19	1394	3.59	1.18	1394	3.96	1.04	1383	4.09	.97
	L	704	3.13	1.31	702	2.87	1.23	698	3.14	1.27	698	3.56	1.18	700	3.81	1.09
		t=5.976, df=1295.641, p<.01			t=8.529, df=2096, p<.01			t=7.858, df=2090, p<.01			t=7.593, df=1245.392, p<.01			t=5.859, df=1266.807, p<.01		
IW	H	1401	3.28	1.26	1396	3.41	1.28	1394	3.67	1.23	1394	3.86	1.14	1386	3.88	.87
	L	704	3.15	1.27	702	3.17	1.30	698	3.40	1.32	699	3.65	1.19	697	3.75	.96
		t=2.268, df=2103, p<.05			t=4.085, df=2096, p<.01			t=4.503, df=1311.240, p<.01			t=3.820, df=1345.570, p<.01			t=3.084, df=1277.627, p<.01		
IH	H	1401	3.11	1.30	1396	3.44	1.31	1394	3.69	1.27	1393	4.18	1.05	1385	3.22	1.07
	L	704	2.68	1.31	703	2.88	1.36	697	3.17	1.39	699	3.74	1.26	699	2.87	1.10
		t=7.007, df=2103, p<.01			t=9.139, df=2097, p<.01			t=8.260, df=1289.040, p<.01			t=7.821, df=1193.733, p<.01			t=6.879, df=2082, p<.01		
WD	H	1401	2.70	1.20	1396	2.64	1.18	1393	2.57	1.12	1394	2.67	1.14	1381	1.93	.94
	L	704	2.25	1.20	703	2.15	1.12	698	2.11	1.11	699	2.24	1.14	697	1.74	.92
		t=8.209, df=2103, p<.01			t=9.171, df=2097, p<.01			t=8.845, df=2089, p<.01			t=8.141, df=2091, p<.01			t=4.414, df=2076, p<.01		
GD	H	1401	2.88	1.29	1395	2.83	1.26	1391	2.75	1.20	1393	2.75	1.17	1383	1.57	.78
	L	704	2.48	1.30	703	2.39	1.25	698	2.24	1.14	699	2.37	1.19	690	1.47	.76
		t=6.556, df=1397.834, p<.01			t=7.483, df=2096, p<.01			t=9.279, df=2087, p<.01			t=7.034, df=1380.090, p<.01			t=2.610, df=2071, p<.01		

Interview Sample: 5^{th} grade teacher (I = Interviewer, T = Teacher)

I: Firstly, I would like to have your opinions about promoting pupils' positive attitudes towards mathematics learning. Do you think that promoting pupils' enjoyment in learning mathematics is important in mathematics classes? Could you explain your response?

T: Yes, it is. I have three methods which I attempt to use in my mathematics classes. Firstly, I often adopt group activities. I think that it is important to have lessons in which every one feels able to raise their views and knows that no one laughs at them even if they make mistakes. Secondly, I try to give my pupils the opportunities to feel a sense of accomplishment and satisfaction. Thirdly, I try to adopt experimental and practical activities. However, the number of opportunities to teach mathematics by linking their learning with everyday life is reduced as pupils' grades proceed. 5^{th} graders have to learn abstract topics such as fractions. Many 5^{th} graders begin to show an interest in thinking about abstract topics.

I: Can you assess whether pupils are enjoying learning mathematics in your classes? How do you assess it?

T: It is sometimes very difficult to assess the pupils' feelings in mathematics classes from their behaviour or facial expression. I know some children are enjoying doing exercises even though they seem to be doing so glumly. Others, who are not willing to raise their hands, sometimes are highly interested in learning mathematics. In contrast, some children who raise their views very frequently do not necessarily enjoy learning. I have many opportunities to observe other teachers' classes, just as I open my classes to other teachers to observe. I think we know whether children are enjoying classes from the classroom atmosphere. In such classrooms, the whole class seems united and all the children seem to be learning for a common goal. We can cultivate our competencies in assessing children's affective attitudes from the classroom atmosphere through the experiences of observing pupils.

I: Do you think it is important to keep pupils' motivation to learn mathematics high?

T: Yes, I think that it is important to keep pupils' motivation to learn mathematics high. I think that promoting pupils' understanding of the curriculum is one method of maintaining their motivation. I try to proceed with lessons in a slow pace, so that every one can understand the curriculum. I also adopt practical and experimental work. Pupils enjoy learning mathematics through these activities.

I: Do you think it is important to ensure that pupils feel secure in mathematics learning?

T: I think that enjoyment, motivation, and feeling secure are correlated. If pupils cannot feel secure in mathematics learning, they cannot enjoy it, vice versa. I think that pupils may come to dislike mathematics learning for other reasons than the difficulties of learning mathematics. Pupils are forced to think about matters quickly in their life. Many children are not good at examining problems carefully. Children of today don't know or understand about co-operation and mutual support with peers. For example, they are poor at discussion skills such as understanding what others are saying and expressing their views in public. I think it is important to learn how to communicate with peers in mathematics classes. Communication with peers should not be limited to exchanging greetings. They need to learn how to discuss abstract concepts with peers.

I: Do you think it is important to ensure that pupils are aware of their progress in mathematics learning?

T: Yes, I think it is important.

I: When do you think that pupils themselves have a sense of progress in mathematics learning?

T: I think that pupils have a sense of progress when they can get high marks in tests, when they can raise their views in discussion, and when many peers approve of their views. However, children's actual attainments are not necessarily linked to their fondness for learning mathematics or their confidence in learning mathematics. You can find many elementary school pupils who don't like mathematics, even though their attainment is high. See mathematics education in other countries. Children say that they like mathematics in the countries which consider individual differences. Learning mathematics is not a pain for them because they learn according to their attainment, the goal is within their reach. Japanese pupils are encouraged to tackle difficult tasks, and therefore come to dislike mathematics. But, parental expectations seem to be changing these days. Parents focused on improvement in their children's attainments decades ago, but parents of today seem to encourage their children's development in forming their personality and relationships between peers. The social trend also seems to be changing. The current educational reforms, with the reduction of the curriculum content and number of lessons may affect pupils' attainment negatively. But, I think this policy will work positively to promote pupils' affective aspects.

I: Next, when do you feel that your pupils make progress in mathematics learning?

T: Progress in mathematics learning for me is different from pupils' views. I think that progress in mathematics learning can be measured from the extent to which the pupil can develop their mathematical ideas. Developing pupils' mathematical ideas sounds vague. But, I think developing their inductive thinking competencies is most important. "Inductive thinking competencies" means the process of collecting as much information as possible to lead to a conclusion. For instance, children tried to establish many triangles and then made a formula [the base x the height x ½]. This is inductive thinking. It is important to make them notice that such inductive thinking can be used for establishing the area of a trapezium. Otherwise, children have to memorise formulas and how to manipulate them. Learning through inductive thinking gives children inspiration. Each unit contains opportunities to develop children's inductive thinking. I value such opportunities.

I: I think some pupils are accustomed to learning mathematics through memorising the formula. How do you encourage such pupils to develop their inductive thinking?

T: Actually, it is difficult. Some children have already learned the formula before I take up the topic in the class. For these children, I try to develop their deductive thinking. I encourage them to explain why the formula is valid. However, I encourage other pupils to develop their inductive thinking and make them experience how learning mathematics through inductive thinking gives them inspiration. Then, pupils come to be fond of using inductive thinking and avoid memorising the formula.

I: This time, I would like to have your opinions about teaching methods in your mathematics classes. First of all, could you explain the teaching pattern you adopt in your mathematics classes?

T: I often adopt problem-solving teaching methods at the introductory stage, aiming to encourage pupils to build up new mathematical concepts. Problem-solving teaching methods start with encouraging pupils to try to solve the problems individually, and afterwards, lead to a conclusion through discussion in a group. I give them opportunities to discuss in a small group or as a whole class. I sometimes give them questions to encourage them to develop ideas.

I: Do you sometimes use practical activities?

T: I often use tangible objects. Pupils learn mathematics through experience if they learn the subject with tangible objects. Pupils are more likely to be able to keep the learning content in long-term memory when they learn it through experience than when they memorise the formula. Pupils can remember the experience itself. They may forget the formula easily, but they are less likely to forget the experience.

I: Do you use computers in mathematics classes?

T: I would like to use computers in mathematics classes because children are probably interested in learning mathematics by using computers. But the computers at my school were acquired long ago. This means that the new software cannot be adjusted for the computers. Anyway, I think, computer software programmes which help pupils with learning mathematics autonomously have not been developed yet.

I: How do you use textbooks in mathematics classes?

T: I normally don't use textbooks. I don't agree with the view that teachers should teach the contents written in the textbooks in order. I think that the textbook is just one of the teaching resources. Therefore, I try to give my pupils questions which develop their mathematical ideas.

I: Do you give pupils the opportunities to do practice individually in mathematics classes?

T: Yes, I do. I help them. Pupils can also help each other in a group. So, I prefer giving them individual help in break time and after school. Children do not like being in detention if detention is given only to the children who cannot manage the tasks. So, I avoid putting certain pupils into detention. Rather, I tell them that they can continue to study after regular lessons if they want my help. Few pupils want to attend the sessions. Unfortunately, I sometimes find that pupils who need my help do not always want to stay after school.

I: Do you give pupils different tasks according to their attainments in mathematics classes?

T: I normally give the same task to every one in a class. I don't think that teaching them through different tasks in the same class is an effective measure to help them effectively. I give them the same tasks, but I allow them to do different amounts of tasks according to their learning pace. For instance, give fewer practices to the children who are not accustomed to the procedures yet. They need to learn how to use the procedures slowly and carefully until they are accustomed to using them.

I: Do you use discussion in mathematics classes?

T: Yes, as I mentioned before, I often use discussion in my mathematics classes. This is because discussion is an effective measure to develop pupils' mathematical ideas.

I: Do you think that employing various kinds of teaching methods in mathematics classes is effective in promoting pupils' affective attitudes towards mathematics learning? Please explain your answer.

T: I think teachers should adopt various teaching methods. I believe that pupils come to learn mathematics by whatever teaching method is often used, and they have good experiences such as experiencing approval or coming to understand through that teaching method. I often use discussion in mathematics classes. Thus, my pupils will come to like taking part in discussion. Therefore, I don't think it a good idea to select a single teaching method at elementary school level. Rather, they should experience various teaching methods. Teachers should use various teaching methods, irrespective of pupils' attainments. I don't think that high achievers should learn abstractly and low achievers need tangible things. Both high and low achievers should learn mathematics through various methods. Some high achievers cannot apply their knowledge in practical situations. They memorise formulae and manipulate them. But they don't know how such formulae can be applied in practical situations, so they cannot understand the usefulness of these formulae. You can find Individual differences among pupils with similar mathematics attainments. Adopting various teaching methods allows for such differences. I think we need to develop not only pupils' mathematics attainments but also their personality. For instance, they can learn how to listen to others and how to raise their views in mathematics classes. So, using discussion in mathematics classes is very important. But some pupils prefer learning mathematics individually. Providing the opportunities to learn mathematics individually is important for them. So it is important to use various methods.

Interview Sample: 8^{th} grade teacher (I = Interviewer, T = Teacher)

I: Firstly, I would like to have your opinions about promoting pupils' positive attitudes towards mathematics learning. Do you think that promoting pupils' enjoyment in learning mathematics is important in mathematics classes? Could you explain your response?

T: Yes, I think so. It is very important for me to make pupils enjoy learning mathematics. However, not all of the children are interested in the same topic or the same materials. So, I don't think that I can make all of the children in my class enjoy learning mathematics all the time.

I: Can you find the pupils who enjoy and those who do not enjoy mathematics classes?

T: I can notice the pupils who feel bored in class. When pupils feel bored with lessons, they do not reply to my questions and lose their concentration on the tasks. On the other hand, I can see in the pupils' eyes when the lesson is enjoyable. They can concentrate on tasks when they enjoy doing them.

I: Do you think it is important to keep pupils' motivation to learn mathematics high?

T: Yes, I think so. Many pupils seem to be motivated to learn in the introductory stage. However, some pupils cannot keep up with the class and lose their motivation to learn. Other pupils who can keep up with the class feel able to try hard to learn the topic. I can observe the difference; first of all, their facial expressions and concentration on task differ between motivated and unmotivated pupils. I walk between the desks in order to provide pupils with individual support while they are working individually. Pupils who are unmotivated are not willing to ask questions even if they don't know the procedure. When they have lost their motivation to learn, their expectation of mastering the content gets weaker.

I: Do you think it is important to ensure that pupils feel secure in mathematics learning?

T: I don't think it is a big issue in mathematics learning. I think pupils' sense of security is not emphasised greatly in my mathematics classes. But I try to have a classroom ethos whereby pupils can point out their lack of understanding of the curriculum when they are unsure about what they are learning. I try to set questions so that pupils who are not good at mathematics can reply. So, pupils can raise their views.

I: So, pupils feel able to raise their views in a class?

T: I cannot say that all of the pupils in my class can raise their views. But I do not imagine that some pupils feel difficulties in raising their views because of the pressure from peers.

I: Do you think it is important to ensure that pupils feel progress in mathematics learning?

T: I think that ensuring that pupils feel progress in mathematics classes is one of the educational aims in mathematics classes. Pupils seem to feel progress when they can reply to my questions in mathematics classes. I think that understanding is a key factor contributing to their sense of progress. Their attainments can surely improve when they want to understand the curriculum.

I: This time, I would like to have your opinions about teaching methods in your mathematics classes. First of all, could you explain the teaching pattern you adopt in your mathematics classes?

T: In the introductory stage, I give them examples and encourage them to explain their ideas in their own language. I think that this is an effective measure to help them to understand mathematical concepts. I devote time to making them do practices in order to develop their abilities to deal with mathematical problems. I think it is important to make them confirm what they have already mastered and have not mastered yet through doing practices. Thus, doing practices and exchanging ideas in the whole class are frequently adopted methods in mathematics classes.

I: Do you sometimes use practical activities?

T: I use practical activities when I teach them solid geometry. Pupils make polyhedrons and examine the structure. Practical activities can promote pupils' understanding of the curriculum. Pupils do not seem able to apply what they have learned through activities to other problems. So learning mathematics through activities does not lead to an improvement in test results. Pupils enjoy practical activities, but learning mathematics through activities does not necessarily lead to the improvement of attainment.

I: So you think that pupils enjoy learning mathematics through practical activities. But you doubt how far this teaching method can promote pupils' attainments. Is my understanding right?

T: Teaching mathematics through practical activities seems to be more time-consuming than other methods. Pupils are very busy. They need to learn a lot of subjects and attend many school activities. It is very difficult to know how teachers can teach mathematics effectively through practical activities in limited time. Teachers also need to learn how to teach mathematics through practical activities. We need to collect the materials and exchange materials which other teachers find successful to use in their classes.

I: Do you use computers in mathematics classes?

T: I hardly ever teach mathematics with computers on the grounds that we don't have good software at present. They are very much improved, but I think they are still less than satisfactory. Children may have too great expectations of learning mathematics by computers. They misunderstand their interest in using the computer as an interest in learning mathematics. Actually, children enjoy learning mathematics through computers more than doing practice in their notebooks. But such enjoyment does not lead to the improvement of their attainment. Even among the high achievers taking additional mathematics classes, their interest in using computers seems to vary. Some want to make programs, others want to use computers for input. I don't think using computers can meet children's expectations. It may produce disappointment. But I found that pupils are interested in using a computer for computer graphics. They showed interest in the computer graphics which I used in the teachers' room. I came to think that using computers in mathematics classes could promote pupils' enjoyment and motivation.

I: How do you use textbooks in mathematics classes?

T: I hardly ever use textbooks. I use them when the textbooks can explain effectively what I want to teach to my pupils. But I normally try to explain to them by myself without relying on textbooks.

I: Do you use discussion in mathematics classes?

T: I prefer whole class discussion to group discussion. I use group discussion only when findings are discussed in the whole class afterwards. Pupils can learn from each other in a group. I gave them a problem, for instance, finding out the equalities whose answer is one to ten, using four 4s. High achievers can find all the answers by themselves, while other pupils find only a few answers. Pupils can share the views and help each other in a group. I encourage my pupils to co-operate when they do practices.

I: Do you think that employing various kinds of teaching methods in mathematics classes is effective in promoting pupils' affective attitudes towards mathematics learning? Please explain your answer.

T: It depends on which should be emphasised in mathematics teaching, building up the concepts or the acquisition of skills. I think that building up the concepts has been cut off in the new curriculum, under the name of ensuring that all the pupils can understand the curriculum. For instance, the new curriculum does not include inequality. Pupils learn equality but they lose the opportunities to learn inequality. But the concepts used for inequality and those used for equality are different. This is not just a difference in the skills needed for solution. So if pupils do not have the opportunities to learn inequality, they lack the opportunities to build up the concepts of inequality, and this may influence their abilities to build up the concepts of equality. Adopting various teaching methods is a good measure to build up pupils' concepts. But if the acquisition of skills should be emphasised, teachers do not need to prepare various teaching methods. Making them to do a lot of practice and making them accustomed to manipulation of the procedure is the most effective measure to acquire skills. The acquisition of fundamental skills such as being able to calculate is important for more advanced problem solving. But I think helping pupils to build up their concepts is very important.